Draft Supplemental Environmental Impact Statement
and
MEPA Notice of Project Change (EOEA #8695)
for the
Boston Harbor Inner Harbor Maintenance Dredging Project

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This joint Federal and State document builds on the lessons learned from the Boston Harbor Navigation Improvement Project (BHNIP) located in Massachusetts, which was the subject of the Final Environmental Impact Report/Statement (EIR/S) prepared in 1995. The currently proposed Inner Harbor Maintenance Dredging Project (IHMDP) involves dredging approximately 1.7 million cubic yards (cy) of silty maintenance material from the Main Ship Channel located approximately halfway between Spectacle Island and Castle Island upstream to the Inner Confluence, the upper Reserved Channel, and the approach to the Navy Dry Dock to their authorized depths. Approximately 1.3 million cy of the maintenance material is unsuitable for unconfined open water disposal and will be disposed into confined aquatic disposal (CAD) cells located in or near the sites identified in the BHNIP EIR/S. The CAD cells will be located in the Mystic River navigation channel and the Main Ship navigation channel. The silty maintenance material suitable for ocean disposal and the 1.5 million cy of parent material removed to construct the CAD cells will be disposed at the Massachusetts Bay Disposal Site.

Comments should be sent to Colonel Curtis L. Thalken at the U.S. Army Corps of Engineers and Secretary Stephen Pritchard, attn: Deirdre Buckley, Massachusetts Environmental Policy Act Office, 100 Cambridge St, Suite 900, Boston, MA 02114 by the date indicated in the Notice of Availability. Additional information can be obtained from Mr. Michael Keegan of the U.S. Army Corps of Engineers at (978) 318-8087 or Ms. Jacki Wilkins of Massport at (617) 568-3558.

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BOSTON HARBOR INNER HARBOR MAINTENANCE DREDGING PROJECT

EXECUTIVE SUMMARY

Project Description

This joint Federal and State document builds on the lessons learned from the Boston Harbor Navigation Improvement Project (BHNIP) located in Massachusetts, which was the subject of the Final Environmental Impact Report/Statement (EIR/S) prepared in 1995 (Corps and Massport, 1995). The currently proposed Inner Harbor Maintenance Dredging Project (IHMDP) involves dredging approximately 1.7 million cubic yards (cy) of silty maintenance material from the Main Ship Channel located approximately half-way between Spectacle Island and Castle Island upstream to the Inner Confluence, the upper Reserved Channel, and the approach channel to the Navy Dry Dock to their authorized depths. Approximately 1.3 million cy of the maintenance material is unsuitable for unconfined open water disposal and will be disposed into confined aquatic disposal (CAD) cells located in or near the sites identified in the BHNIP EIR/S (Corps and Massport, 1994, 1995).

Recent geotechnical investigations in the Mystic River and the Inner Confluence (i.e., locations of the CAD cells identified in the BHNIP) revealed the presence of ledge that limits potential capacity of CAD cells in many of these locations. This constrains the construction of new CAD cells in these areas. Based on these geotechnical investigations, it was determined that a single CAD cell constructed in the Main Ship Channel could confine the majority of the dredged material unsuitable for ocean disposal. A “starter cell” for the Main Ship Channel maintenance material would be constructed in the Mystic River.

The silty maintenance material suitable for ocean disposal and the approximately 1.5 million cy of parent material removed to construct the CAD cells will be disposed at the Massachusetts Bay Disposal Site (MBDS). The total amount of material to be dredged from the project and disposed into CAD cells or the MBDS is approximately 3.2 million cy. In addition to the dredged material, about 12,000 cy of rock will be removed. Recent surveys have identified some areas of ledge within the Federal navigation project that will also be removed as part of this maintenance dredging effort: a section of ledge, located in the Main Ship Channel between the 35 and 40-foot channels; as well as six separate ledge outcrops in the west end of the President Roads Anchorage. Dredging and disposal activities are expected to take about two years to complete. See Figure ES-1.

The U.S. Army Corps of Engineers (Corps), Massachusetts Port Authority (Massport) and the Commonwealth of Massachusetts continue to work together to have Keyspan Gas remove its gas siphon in the Chelsea River located south of the Chelsea Street Bridge. The continued presence of this pipeline prevented completion of BHNIP dredging in this area. If the line is removed prior to completion of the Inner Harbor Maintenance Dredging Project, the BHNIP maintenance and improvement dredging will be performed in this area to deepen the Chelsea River to its –38 foot MLLW authorized depth. If the line is not removed, then the Chelsea River area will be maintenance dredged to –35 feet MLLW. The material will be disposed into CAD cell C12, located north of the Chelsea Street Bridge, which was permitted and constructed for the BHNIP.

Purpose and Need

The purpose of the proposed IHMDP is to restore the Federal navigation channels to their authorized depths. Dredging is needed to remove shoals in the navigation channel that are impacting ship traffic in Boston Harbor. In some instances, delays have caused vessels to cancel their stop in Boston because of the impact the delay would have on scheduled stops in other ports of call. In addition to the tidal delays, navigation interests have had to restrict the draft of vessels utilizing the project, because shoaling of up to five feet above authorized depths now exists in portions of the channel. This is seriously impacting the economic efficiency of the port by limiting vessel drafts that can use the harbor without significant delays or restrictions. It also has a significant impact on the economics of shipping through Boston since some ships need to be "light loaded" (vessels not loaded to capacity) or lightered (transfer of goods) to avoid delays. Light loading increases the cost of transportation and the cost of the shipped products to the consumer. Shoaling has also caused concerns regarding damages to vessels as well as safety conditions related to vessel movement, such as groundings.

Public Participation

The public was notified of this project and invited to participate in the direction of the IHMDP through several means. On April 25, 2005, a Notice of Intent (NOI) to prepare a Supplemental Environmental Impact Statement (SEIS) was published in the Federal Register. The NOI notified the public that an EIS would be prepared and allowed the public to comment on the proposed action. Interested individuals could also request to be placed on mailing lists for potential meetings and future publications of the SEIS.

A public notice describing the proposed project was released for public comment on June 17, 2005 with a 30-day comment deadline. A request for a public hearing was received from Bosport Docking, LLC in Boston, MA. However, conversations with the general manager indicated that a meeting would be adequate to address their concerns about the need for the dredging in the Charles River and potential damage to docks from the dredging operations. This meeting was held August 4, 2005 between Corps and Bosport Docking staff.

In accordance with the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA) process, the public has the opportunity for comment throughout the SEIS/NPC process through public information meetings, working group sessions, verbal, and written communication avenues with the Corps and Massport and public comment periods on the Draft and Final SEIS and accompanying NPC. As with the BHNIP, a Technical Working Group (TWG) was established to assist in the planning and review of the SEIS/Notice of Project Change (NPC) for this maintenance dredging project. The TWG was comprised of representatives from Federal, State, and local resource agencies, environmental advocates, scientists, and Port-of-Boston stakeholders.

This Draft SEIS and NPC are published together to provide an opportunity for public review and comment. A minimum 45-day public comment is provided once a Notice of Availability of the Draft SEIS/NPC is published in the Federal Register. A Final SEIS will be prepared once comments have been received on the Draft SEIS. The Corps will prepare a Record of Decision for publication in the Federal Register not sooner than 30 days after the public release of the FSEIS.

Disposal Alternatives

Both NEPA and MEPA require a discussion of alternatives to the project, including the "No Action" alternative. Since this is a Supplemental EIS/NPC, the preferred design is evaluated in the context of the alternatives addressed in the BHNIP.

During preparation of the BHNIP, over three hundred and seventy (370) disposal sites were identified and evaluated. A Disposal Options Working Group was convened to develop criteria for use in the evaluation and screening of a universe of potential sites (and to screen the various alternatives) and develop a short-list of preferable disposal and beneficial use options for parent material (Boston blue clay), rock, and silts. In addition, disposal alternatives for future maintenance dredged material were also developed. Because of the large quantity of parent material to be dredged during the BHNIP, mostly Boston blue clay, and the limited alternatives available for disposal, it was determined that the most practicable and environmentally acceptable alternative was to dispose of the material at the Massachusetts Bay Disposal Site (MBDS). Therefore, the screening processed focused on developing disposal alternatives for the 1.3 million cubic yards of silty maintenance material, which was unsuitable for ocean disposal from that project.

This IHMDP reviewed the seven sites identified as potential disposal sites for future maintenance dredged material in the BHNIP FEIR/S. The seven sites include the Massachusetts Bay Disposal Site (MBDS), Subaqueous B and E, Meisburger 2 and 7, Boston Lightship, and Spectacle Island CAD. See Figure ES-2. The MBDS is an EPA-designated ocean disposal site that is currently open for disposal of material that meets the testing protocol for material suitable for ocean disposal. The Boston Lightship site is a former disposal site. Both sites are located beyond the baseline of the Territorial Sea and are subject to Marine Protection Research and Sanctuaries Act (MPRSA). However, while MBDS is an EPA-designated disposal site, the Boston Lightship would need to go through a lengthy site selection process before disposal could be considered and would impact a site that is recovering from previous disposal. Therefore only material suitable for ocean water disposal will be disposed at the MBDS.

The Subaqueous B and E sites, the Meisburger sites and the Spectacle CAD sites are all located in previously undisturbed areas. Therefore these sites are not as desirable as disposal sites in areas that have been previously impacted (i.e. the Federal navigation channels in Boston Harbor). The in-channel CAD cell disposal sites were selected as the preferred alternative for disposal of the unsuitable material.

No beneficial uses for the silty maintenance material or the underlying parent material are known. The rock from the President Roads Anchorage area will be disposed at a separate location within the MBDS to increase habitat diversity.

Lessons Learned from the Previous BHNIP

Extensive environmental monitoring was conducted during construction of the BHNIP as a requirement of the Water Quality Certification (WQC) as discussed further in the Environmental Consequences Section of the SEIS. Environmental monitoring required as part of the WQC included: 1) silt plume tracking during dredging of and after disposal into CAD cells, 2) water quality testing after disposal into the CAD cells, 3) biological testing, 4) dissolved oxygen (DO) testing within and outside the CAD cells, and 5) fisheries monitoring. The results of the monitoring showed no water quality violations or significant impacts to biological resources.

Additional investigations (i.e., outside the scope of the WQC) were performed during construction to address concerns raised by the Technical Advisory Committee (TAC) or to address potential impacts from changes in operations suggested by the dredging contractor. The BHNIP WQC noted that the TAC would support the Department of Environmental Protection during construction. The TAC met periodically to review monitoring results and discuss recommended amendments to the WQC. These additional investigations included water quality monitoring of disposal at low tide, plume monitoring of the Contractor's enclosed bucket, monitoring turbidity caused by vessel passage over an uncapped and capped CAD cell, bathymetric measurements, and lobster monitoring. Monitoring results showed no water quality violations or significant environmental impacts from construction of the project. One-year surveys and five-year surveys of the CAD cells constructed in the Inner Confluence, Mystic River and Chelsea River for the BHNIP have also been completed, as required by the BHNIP Water Quality Certification. The results of the monitoring show that the CAD cells are performing as expected. Experience gained from placing a sand cap on the CAD cells will be incorporated into this project.

As a result of the extensive monitoring conducted for the BHNIP, and the lack of any water quality violations or significant impacts, only confirmatory water quality monitoring during disposal operations is recommended for this project. It is recommended that total suspended solids and turbidity monitoring would be performed during the first time disposal occurs into the Mystic River CAD cell and into the Main Ship Channel CAD cell.

To reduce potential impacts to resources in the project area, based on lessons learned, the following mitigation measures will be implemented:

- An enclosed "environmental" bucket will be used for silt dredging.

- To reduce the effects of turbidity on water quality, no overflow from the scows will be allowed.

- Disposal into the CAD cells will occur only around periods of slack tide: three hours at low tide and high tide (one hour before and two hours after slack tide).

- A three-foot sand cap will be placed in the CAD cells when the silt has consolidated enough to support a cap. The cap material will be released from a moving, not stationary platform. No spudding over the cap or mechanical disturbance of the cap will be allowed.

- To reduce the impact to biological resources from blasting, all blasting will be conducted using inserted delays of a fraction of a second per hole. Rock or similar material will be placed into the top of the borehole to deaden the shock wave reaching the water column. A fisheries and mammal observer, and fish detecting sonar system, will be used to avoid blasting when mammals are present in the area or when significant schools of fish are observed.

- A fisheries observer, sonar detection, and a startle system from February 15 to June 15 will be required for the Mystic River and Main Ship Channel CAD disposal activities to avoid disposal during the presence of anadromous fish migration.

- To reduce potential impacts to egg-bearing lobsters that are less mobile in the colder months, no dredging or blasting will occur seaward of the Third Harbor Tunnel between December 1 and March 31.

- A marine mammal observer will be on board the scows transiting to the MBDS from February 1 to May 31 to avoid potential ship strikes with marine mammals, and in particular the North Atlantic Right Whale.

- Rock removed from the Presidents Road Anchorage area will be placed within a new area of the MBDS to increase habitat diversity.

- The dredge contractor will provide advance notice to the lobstermen on anticipated significant dredge movements.

Based on incorporation of the above mitigation measures, the experience gained during construction of the BHNIP, and lack of any water quality violations or other significant effects from the BHNIP, no significant impacts to the environment are expected from the IHMDP.

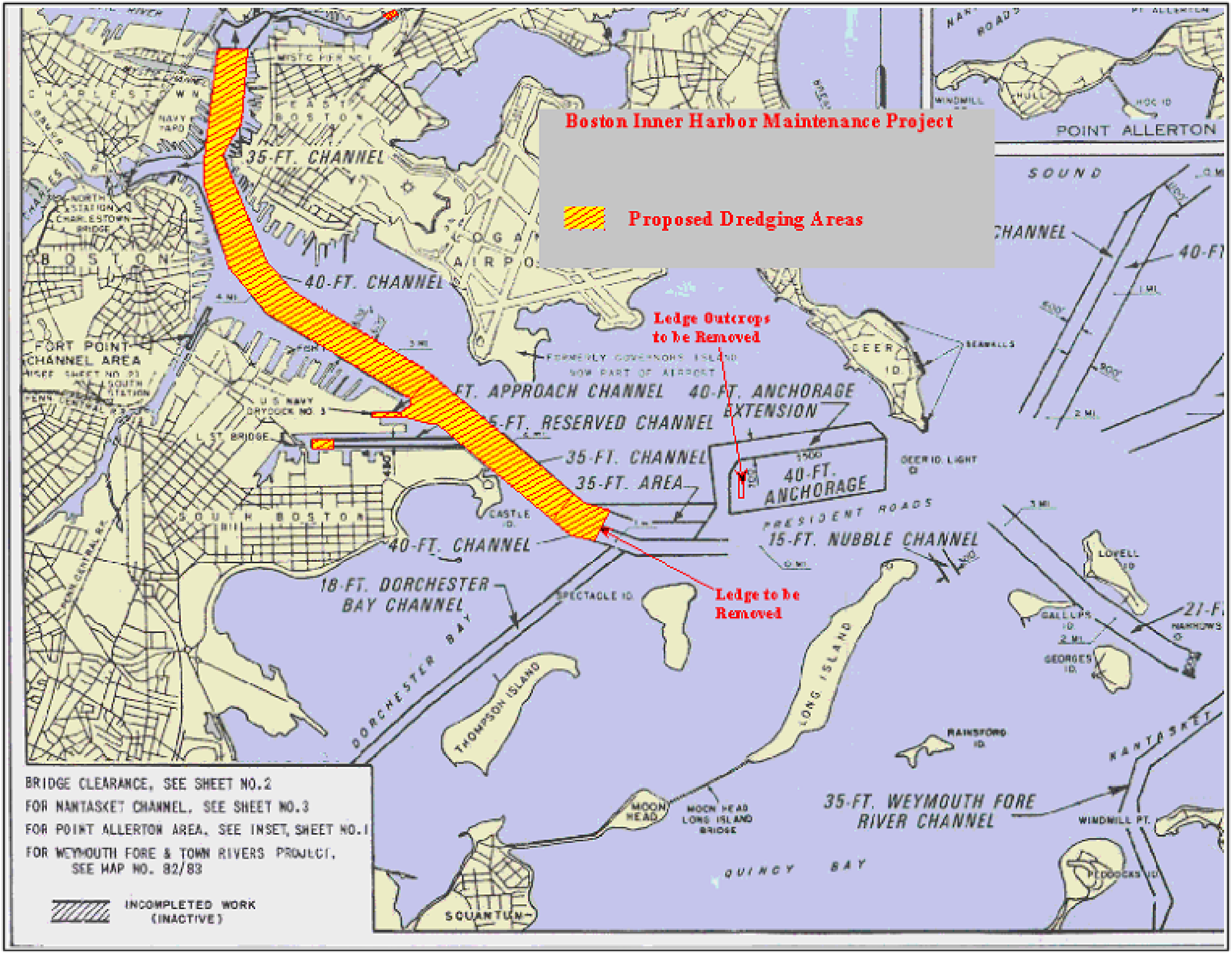


Figure ES-1. IHDMP Dredging Areas

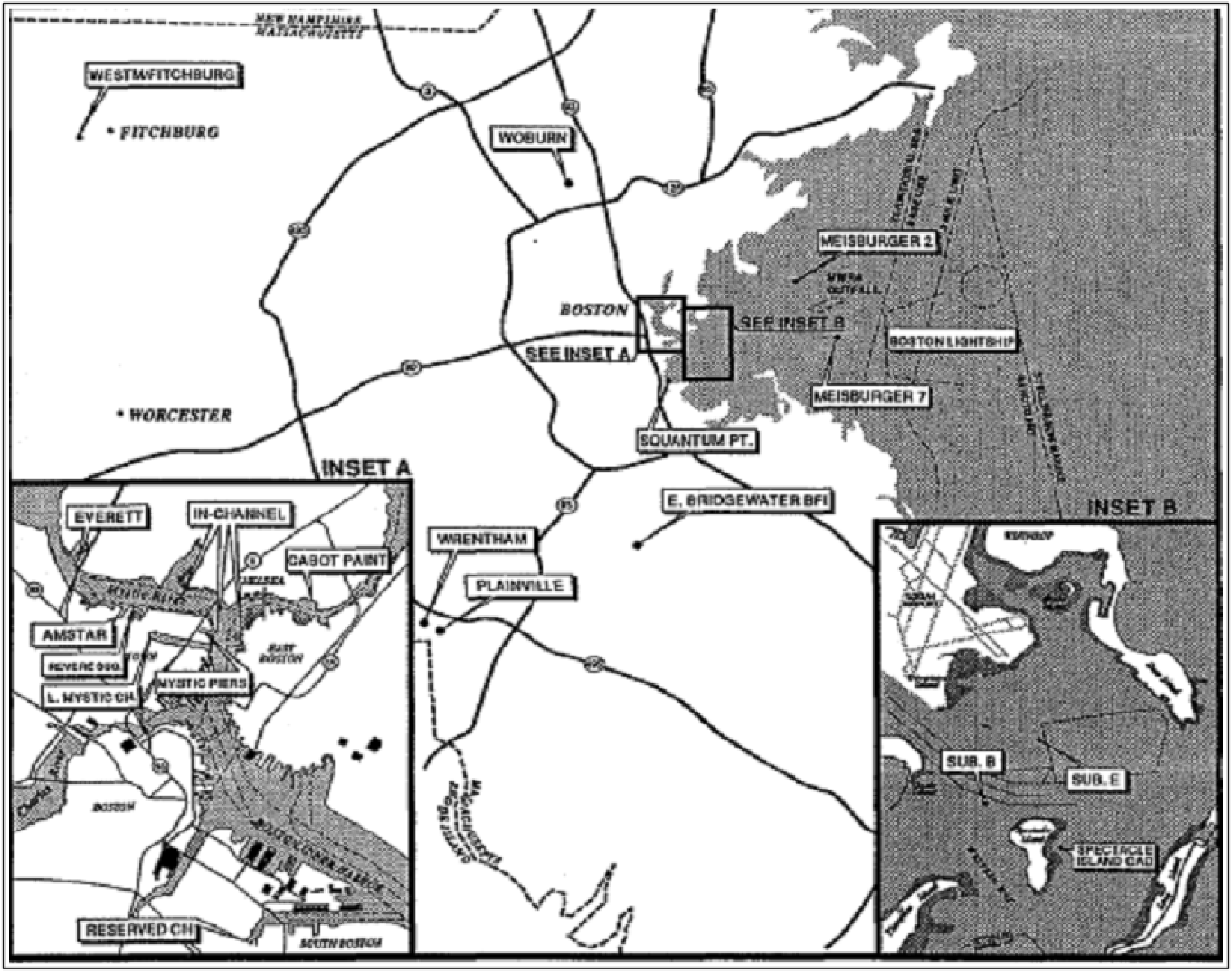


Figure ES-2. BHNIP Short Listed Sites

<u>Boston Harbor Inner Harbor Maintenance Dredging Project</u>

1.0 Introduction

1.1 Project Purpose and Need

Purpose of the Action

The purpose of the Boston Harbor Inner Harbor Maintenance Dredging Project (IHMDP) is to restore the authorized depths of the Federal navigation channels of the Main Ship Channel from a point halfway between Spectacle Island and Castle Island upstream to the Inner Confluence, the upper portion of the Reserved Channel and the approach channel to the Navy Dry Dock in South Boston. In conjunction with this work, the Corps also hopes to complete maintenance and improvement dredging surrounding the Keyspan Gas Siphon in the Chelsea River, as long as the pipeline is removed in time.

Recent maintenance dredging of the navigation channels in Boston Harbor occurred in:

- 2004-2005 with the removal of approximately 1.1 million cubic yards (cy) of maintenance material from the Broad Sound North Channel, President Roads Channel and Anchorage and portions of the Main Ship Channel from a point halfway between Spectacle Island and Castle Island outbound;
- 1998-2001 in the Mystic River, Chelsea River and Lower Reserved Channel with the removal of approximately 980,000 cy of maintenance material prior to improvement dredging in those reaches (as part of BHNIP);
- 1982-1983, when about 486,000 cy of material was dredged from the Mystic River, Chelsea River and President Roads Anchorage.

Need for Maintenance Dredging

The Port of Boston serves the six-state New England region, and is the region's primary container port. Large tankers and freighters, which transit the harbor to load and unload goods, have been experiencing significant tidal delays due to shoals that have developed since the last maintenance dredging of inner portions of the Main Ship navigation channels in 1969. In some instances, these delays have caused vessels to cancel their stop in Boston, or depart Boston without loading or discharging all of their cargo because of the impact the delay would have on scheduled stops in other ports of call. More than 600 vessel moves in Boston Harbor in 2004 were tidally restricted.

In addition to the tidal delays, navigation interests have had to restrict the draft of vessels utilizing the project since shoaling of up to five feet above authorized depths now exists in portions of the channel. This is seriously impacting the economic efficiency of the port by limiting vessel drafts that can use the harbor without significant delays or restrictions. It also has a significant impact on the economics of shipping through Boston since some ships need to be "light loaded" to avoid delays. Light loading increases the cost of transportation and the cost of the shipped products to the consumer. Shoaling has also caused concerns regarding damages to vessels as well as safety conditions related to vessel movement, such as groundings.

Congressional Authorization

Boston Harbor and its navigable tributaries have been extensively improved and developed by the U.S. Army Corps of Engineers (Corps) and State and local interests. The first Federal Boston Harbor navigation project was authorized in 1822. The most recent improvements and modifications were authorized by the Water Resources Development Act of 1990, for which the Boston Harbor Navigation Improvement and Berth Dredging Project (BHNIP) Environmental Impact Report/Statement (EIR/S) (Corps and Massport, 1994, 1995), which this document supplements was prepared. These modifications consisted of deepening portions of the Mystic River, Inner Confluence and lower Reserved Channel) from -35 feet mean lower low water (MLLW) to -40 feet MLLW. In addition, a small section of the -35-foot Main Ship Channel across from the Reserved Channel was deepened to –40 feet MLLW to aid in turning of vessels into the Reserved Channel. The Chelsea River channel, which serves the majority of the petroleum needs of the region and supplies fuel to Boston's Logan Airport, was deepened from -35 feet MLLW to -38 MLLW. In addition, non-structural improvements to realign the main entrance and approach channels by designating Federal channel limits and repositioning navigation buoys were also authorized. These modifications, known as the Boston Harbor Navigation Improvement Project, were completed in 2001. See Figure 1-1.

The current relevant authorized Federal navigation project consists of the following features that the Federal Government is responsible for:

- A channel 35 feet deep along the same line as the 40-foot Main Ship Channel in the following manner, adjacent to the westerly side of the 40-foot Main Ship Channel through Broad Sound, 600 feet wide, a distance of about two miles; adjacent to the northerly side of the 40-foot main ship channel from President Roads to abreast of the Fish Pier, 600 feet wide a distance of about three miles; adjacent to the westerly side of the 40-foot main ship channel from abreast of Fort Point channel to the Charlestown Bridge at the entrance to Charles River, to the southern limit of the Inner Confluence of the Mystic River and the Chelsea River having widths varying from 100 to 1,000 feet, a distance of about two miles;
- A channel 40 feet deep in general, but 45 feet through rock, 900 feet wide, widening at the outer end to 1,100 feet from the sea to President Roads, through Broad Sound;
- Present 40-foot channel extending from President Roads to Mystic Pier No. 2, Charlestown, generally 600 feet wide with suitable widening at the bend opposite Commonwealth Pier No. 5 and 600 to 900 feet in the upper reaches;
- An anchorage 3,150 feet wide by approximately 5,500 feet long (420 acres in size) and 40 feet deep on the north side of President Roads;
- A 40 foot deep approach channel to the U.S. Navy Dry Dock at South Boston between the Main Ship Channel and the U.S. Harbor line;

- The Reserved Channel provides for a depth of 40 feet and a width of 430 feet extending about one mile from the 40-foot main ship channel to the L Street Bridge, with the exception of the upper 1,340 feet that remains at 35 feet deep. The channel has been widened and deepened to 40 feet at the confluence of the Reserved Channel, Main Ship Channel, and Dry Dock Channel; a trapezoidal area of the 35-foot Main Ship Channel has been deepened to 40 feet;
- The Chelsea River provides for a navigation channel 38 feet deep and generally 225 to 250 feet wide, widened to the fenders at the bridge openings, and 250 to 430 feet wide above the bridge with a turning and maneuvering basin 38 feet deep, generally 800 feet wide and 1,000 feet long.
- Mystic River channel provides for a channel 40 feet deep for 5,670 feet and a 35-foot deep channel for 900 feet upstream to the Malden Bridge. The Mystic River channel is 580 feet wide through the Tobin Bridge, 740 to 700 feet wide from the bridge upstream to the Island End River, widening to 930 feet at the Island End River, widening further to 960 feet at the Exxon Terminal then narrowing to 440 feet at the Distrigas Pier continuing upstream to the Prolerized Wharf to a depth of 40 feet MLW. Areas upstream would remain at 35 feet deep. Only the lower portion of the Mystic River navigation channel that serves deep-draft commercial interests has been described.
- The Inner Confluence was deepened to 40 feet as well as about 2,500 feet of the 35-foot Main Ship Channel downstream of the Inner Confluence.

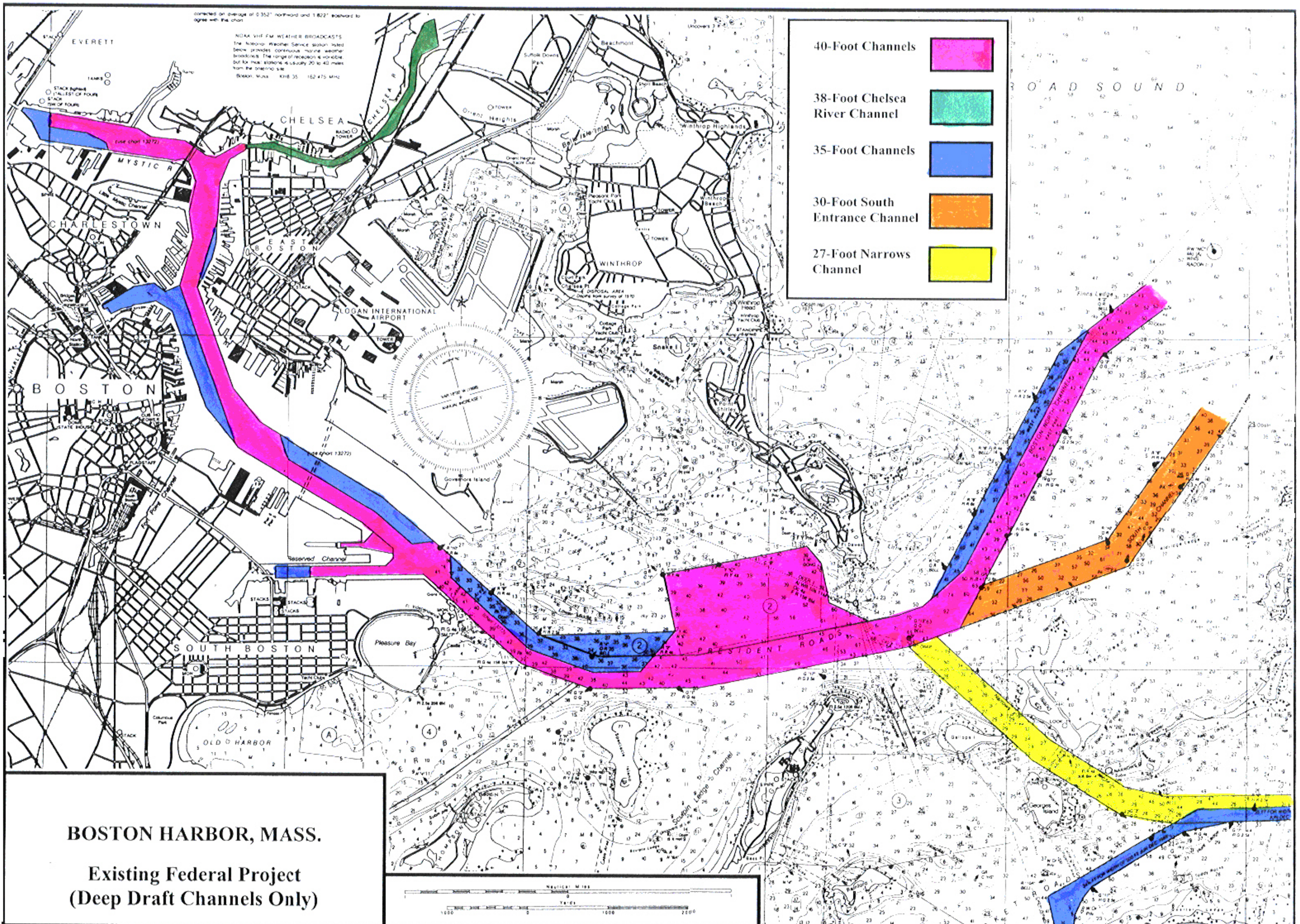


Figure 1-1. Existing Federal Project

Laws and Regulations Governing Dredged Material Disposal

The primary authorities that apply to the disposal of dredged material in United States waters are the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 and the Clean Water Act (CWA) of 1972. The jurisdiction of MPRSA and CWA overlaps within the territorial sea, which is defined as the open water within the States' three-mile Territorial Limit. Where jurisdiction overlaps, CWA takes precedence where dredged material is used as fill, such as beach nourishment, while MPRSA takes precedence for transit of dredged material for disposal purposes other than fill. The Massachusetts Bay Disposal Site (MBDS) lies seaward of the territorial sea baseline and is therefore subject to MPRSA. Disposal into confined aquatic disposal (CAD) cells within Boston Harbor would be subject to the CWA.

Congress enacted the MPRSA of 1972 to address and control the disposal of dredged materials in ocean waters. Regulations implementing MPRSA were promulgated by EPA and are codified at 40 CFR Parts 220-228 (referred to as the Ocean Dumping Regulations). Title 1 of the MPRSA authorized the EPA and the Corps to regulate disposal in U.S. ocean waters. EPA and the Corps share responsibility for managing dredged material. The MPRSA prohibits the disposal of dredged materials into water under its jurisdiction unless conducted in compliance with a permit issued by the Corps under Section 103 of the MPRSA or authorization under the Corps Civil Works Program (33 U.S.C. Section 1411(a) and Section 1413(a)). Corps dredged material disposal permits and authorizations are issued under MPRSA Section 103 and may include conditions deemed necessary by the Corps related to the type of material to be disposed of, time of disposal, and other matters (33 U.S.C. Section 1413 and Section 1414(a)). The dredged material disposal permitting process requires consideration of a range of disposal alternatives, including beneficial reuse and upland treatment and disposal.

The Corps approves a dredging project under its civil works authority only if it has determined that dredged material disposal "will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities (33 U.S.C. Section 1413(a)). The Corps makes MPRSA Section 103 determinations by the standards set forth in EPA regulations (33 U.S.C. Section 1413(b)). EPA has promulgated its ocean disposal regulations pursuant to MPRSA Section 102(a) (33 U.S.C. Section 1412(a), at 40 CFR Parts 220 to 229).

Section 404 of the CWA (33 U.S.C. Section 1344) governs the disposal of fill, including dredged materials, in waters of the United States within the three-mile territorial sea. This applies to discharges landward of the baseline of the territorial sea and in instances seaward of the baseline when intent is to fill or nourish beaches. The Section 404 permit program is implemented by the Corps and covers the discharge or placements of dredged and fill material into inland waters of the United States. As in MPRSA above, the Corps does not issue itself a CWA permit for projects under the Corps Civil Works Authority but does apply the 404 (b)(1) guidelines and other substantive requirements of the CWA and other environmental laws (33 CFR Part 335).

For most dredged material disposal projects, the Corps solicits comments from the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (FWS), EPA, and State regulatory agencies to ensure that the project conforms to applicable State water quality standards (if within the State's territorial waters) and is consistent with the State Coastal Zone Management Act. Corps permit determinations and civil works approvals are also subject to any applicable requirements of other laws (e.g. the Endangered Species Act, the Fish and Wildlife Coordination Act, etc.). See the Environmental Compliance Section below for applicable laws.

1.2 Summary of Major Changes in Boston Harbor Since the 1995 Final Environmental Impact Report/Statement

The Final Environmental Impact Report/Statement (EIR/S) for the Boston Harbor Navigation Improvement Project (BHNIP) was released to the public in June 1995. Since that time, the BHNIP has been constructed and additional maintenance dredging of the navigation channels in the outer portion of Boston Harbor has been completed. Most recently, the Boston Harbor Outer Harbor Maintenance Dredging Project (OHMDP) restored the navigation channels from approximately halfway between Castle and Spectacle Islands seaward as well as the President Roads Anchorage to their authorized depths.

Experience from these projects has guided development of the dredging and disposal program for the IHMDP. Shoaling of the Federal navigation channels between the BHNIP and the OHMDP project footprints has resulted in the need to maintenance dredge the remaining areas of the Main Ship Channel, the upper portion of the Reserved Channel and the approach channel to the Navy Dry Dock. A portion of the Chelsea River, which was previously permitted under the BHNIP, will also be dredged as long as the pipeline is removed in time.

The lessons learned as a result of the extensive environmental monitoring conducted during construction of Phase 1 and Phase 2 of the BHNIP, will be implemented to reduce potential IHMDP impacts. Environmental monitoring required as part of the WQC included:

- silt plume tracking during dredging of and after disposal into CAD cells,
- water quality testing after disposal into the CAD cells,
- biological testing,
- dissolved oxygen (DO) testing within and outside the CAD cells, and
- fisheries monitoring.

Additional investigations, outside the scope of the WQC, were performed during BHNIP construction to address concerns raised by the Technical Advisory Committee or to address potential impacts from changes in operations suggested by the dredging contractor. These additional investigations included:

- water quality monitoring of disposal at low tide,
- monitoring turbidity while using the Contractor's enclosed bucket,
- monitoring turbidity during vessel passage over an uncapped and capped CAD cell,
- bathymetric measurements, and
- lobster monitoring.

Results of the monitoring showed no significant environmental impacts from construction of the project. One-year surveys and five-year surveys of the CAD cells constructed in the Inner Confluence, Mystic River and Chelsea River for the BHNIP have also been completed, as required by the BHNIP Water Quality Certification. The results of the monitoring show that the CAD cells are performing as expected. These monitoring results are discussed in more detail below under each appropriate section of this DSEIS/NPC.

The Final BHNIP EIR/S identified many potential CAD cells in the Mystic River, Chelsea River and Inner Confluence navigation channels. Since only a portion of these identified cells were used in the BHNIP, it was anticipated that the remaining, permitted CAD cell locations would be used for placement of dredged material found unsuitable for open water disposal from this IHMDP maintenance dredging project. However, probings and borings in the Mystic River and the Inner Confluence conducted in design of the IHMDP indicate the presence of rock that limits the capacity in many proposed CAD cell locations within the Mystic River and most of the Inner Confluence. CAD cell availability in the Chelsea River has also been determined to be limited due to subsurface conditions and limited space. Sufficient CAD cell capacity exists to accommodate all the IHMDP dredged material that is not suitable for ocean disposal in the Main Ship Channel just below the Inner Confluence. The IHMDP has identified a "starter" CAD cell in the Mystic River and an additional CAD cell in the Main Ship Channel just below the Inner Confluence for this project.

2.0 Alternatives

Both the National Environmental Policy Act (NEPA) and the Massachusetts Policy Act (MEPA) require a discussion of alternatives to the project, including the "No Action Alternative". The following sections provide a detailed overview of alternatives to maintenance dredging, including dredging methods and disposal options. Since this is a Supplemental EIS/Notice of Project Change, the preferred design is evaluated in the context of alternatives addressed in the BHNIP. In addition, options for beneficial use of dredged materials are considered.

2.1 No Action

Under a No Action Alternative, the Federal navigation channels in Boston Harbor would not be dredged. Failure to dredge Boston Harbor will further restrict and delay commercial deep draft vessels. Shoaling has reduced depths in the channel as much as five feet in some sections of the project area. This situation greatly affects the commercial ships using the harbor. Without maintenance dredging to restore authorized depths in the inner portion of the Main Ship Channel, shippers will experience even longer tidal delays and be restricted to operating within narrower time periods of higher tidal stages. This will increase the cost of shipment of products and will significantly impact the economic viability of the most important port in the New England region. With the increase of costs and the reduction in vessel movement opportunities, it is likely that shippers will by pass the port and will unload product at other ports and ship the products via trucks which could impact limited roadway capacity.

The 40-foot Main Ship Channel into the Port of Boston has shoaled in to the extent that -35 feet MLLW is now the controlling depth. As a result, the deepest draft vessel that can be brought in without any regard to tides is 33 feet. (This does not take into account strong westerly winds that can further reduce available water depths by as much as 2 feet.). In 2005, there were greater than 600 movements in Boston Harbor by "tide-restricted" vessels (i.e., vessels with drafts of 35 feet or greater). This results in a significant and negative economic impact to the region, and it raises significant operational, safety, economic and environmental concerns. The lack of depth would also increase the likelihood of vessel grounding leading to increased ship repair and maintenance costs. Shippers will also need to light load (not load to capacity to reduce draft) or lighter (transfer) their cargo in the outer harbor, thereby increasing costs to consumers and the chances for an oil spill in these harbor areas. In the worst case, these severely shoaled channels could result in a ship grounding, with potentially devastating environmental consequences.

The Port of Boston provides significant economic benefits to the Commonwealth's residents and businesses. The Port is credited with generating 34,000 jobs and has a $2.4 billion annual economic impact. This significant economic benefit could be jeopardized by the current severe state of shoaling in the channels, since the economic viability of any port rests in large part on the depths of its navigation channels. If deep draft vessels cannot safety and efficiently transit the harbor within the channels, significant economic and potential environmental impacts result. Also, waterborne transportation of cargo is the most environmentally sound transportation alternative available. If cargo cannot reach its destination by water, it will be diverted to the highways, resulting in increased air emissions, traffic and deterioration of highways and bridges.

The Boston Harbor terminal operators, and shipping interests were contacted to identify the type and size of vessels currently using the navigation channels and if they were experiencing any delays or impacts associated with the navigation project. The results of this survey were used to determine if maintenance of all or just a portion of the currently authorized navigation channels in the proposed project is required. The analysis determined that maintenance dredging in the Charles River reach would not be needed at this time. The authorized depth in the Charles River is -35 feet MLLW; however five feet of shoal has brought the controlling depth in the Charles River section of the project to -30 feet MLLW. The current users of the Charles River channel are the Navy, the U.S. Coast Guard, and recreational boaters. The Navy is constrained by the depth at their berth that is –27 feet MLLW and only uses the Charles River berth for their smaller vessels. The U.S. Coast Guard also indicated that their vessels berthed in the Charles River do not have transit problems as a result of the current controlling depth. Recreational boats that dock at the marinas in the Charles River have drafts well below 30 feet. Therefore shoaling in the Charles River channel does not affect any of the current operations in that channel and will not be dredged.

2.2 Alternative Dredging Methods

Several types of dredges can be used to remove material from the navigation channels and to construct the CAD cells. The various types of dredging methods that were considered for this project include a hydraulic dredge, a hopper dredge, and a mechanical dredge. The type of dredge proposed for a project is dependent upon the type of material to be dredged and the disposal site selected. Hydraulic dredges consist of a cutter head on the end of an arm connected to a pump, which loosens the bottom sediments and entrains them in a water slurry that is pumped up from the bottom. The material is then discharged away from the channel (side cast), or is pumped via a pipeline to a dewatering area or disposal site. A hydraulic dredge is generally used for sandy material that will be disposed of in an upland area or on a nearby beach, or for pumping any type of unconsolidated material into a confined (diked) disposal/dewatering area.

The silt and clay materials, such as those found in Boston Harbor, are not suitable for beach nourishment. Therefore, a hydraulic dredge would require a diked upland dewatering area that would either be a permanent site for the material, or an area to dry and rehandle the material for future transport to a permanent upland disposal site. An upland disposal site within a mile of the dredging action would need to be identified in order to perform the dredging by hydraulic means. Dredging operations would require a large upland support area with direct access to the harbor. There is no area that meets the requirements for an upland support area available for Boston Harbor. The dewatering sites need to be very large to handle all the silt materials that would be produced from this dredging project. In addition, the silt material could take a long time to dewater. The amount of upland area within the required distance of the dredging is currently not available.

A hydraulic dredge for disposal at the MBDS would not be practicable as the distance from Boston Harbor to the MBDS (about 20 miles) would not only require many booster pumps and be inefficient, but the piping would be a hazard to navigation.

A hopper dredge uses a suction pump similar to a hydraulic dredge to loosen and remove material from the bottom. The material is then deposited into hoppers aboard the dredge vessel. As pumping continues, the solid particles settle while excess water and some material passes overboard through troughs. When the hoppers are full, the suction arm is raised and secured to the vessel, which then travels to the disposal site and releases or pumps off the material from the hoppers. The dredge then returns to the dredging site to begin another cycle. Hopper dredges come in various sizes from a few hundred cubic yards bin capacity to several thousand yards bin capacity. In New England, hopper dredges are most often used to remove sandy material from harbor entrance channels and deposit the material offshore of beaches to nourish littoral bar systems. In order to fill the hopper bins, the water component of the suctioned slurry is allowed to overflow the bins back into the harbor at the dredging site. While generally not an issue with sandy materials, use of a hopper dredge to remove silty materials like those in Boston Harbor would result in additional turbidity at both the dredging site and areas down current from the site. In addition, several hopper dredges would be needed to maintain efficient dredging operations. A hopper dredge would therefore not be a suitable dredge system to use to maintain the navigation channels of Boston Harbor.

Mechanical dredging involves the use of a barge-mounted crane with a clamshell bucket, or a backhoe arm to dig the material from the harbor bottom. Typical dredging buckets come in various sizes from five cubic yards to fifty or more cubic yards. The material is placed in a scow for transport to the disposal site by tug. For open-water or ocean disposal, a split-hull scow is generally used for ease of disposal and to minimize the discharge plume. Although some overflow of water from the scow is typical to maintain efficiency during dredging, it is minimal in comparison to hopper dredge activities. No overflow will be allowed during dredging of the silty maintenance material in Boston Harbor. Material is typically discharged at a dump buoy, or by using preset coordinates monitored by the tug. This point dumping is intended to form a discrete mound of dredged material at the disposal site to minimize off-site migration and assist in monitoring the disposal operation and post-disposal activities at the site such as benthic recolonization.

A mechanical bucket dredge is proposed and recommended for this project due to the silty nature of the material and lack of suitable upland disposal or dewatering areas. An enclosed "environmental" bucket will be used to minimize turbidity when silt is being removed and a clamshell bucket will be used to remove the parent material to form the CAD cells. No scow overflow will occur when dredging the silty maintenance material for the project.

2.3 Disposal Alternatives – Site Screening Process

During preparation of the BHNIP, over three hundred and seventy (370) disposal sites were identified and evaluated. A Disposal Options Working Group was convened to develop criteria for use in the evaluation and screening of a universe of potential sites (and to screen the various alternatives) and develop a short-list of preferable disposal and beneficial use options for parent material (Boston blue clay), rock, and silts. In addition, disposal alternatives for future maintenance dredged material were also developed. Because of the large quantity of parent material to be dredged during the BHNIP, mostly Boston blue clay, and the limited alternatives available for disposal, it was determined that the most practicable and environmentally acceptable alternative was to dispose of the material was at the Massachusetts Bay Disposal Site (MBDS). Therefore, the screening processed focused on developing disposal alternatives for the 1.3 million cubic yards of silty maintenance material, which was unsuitable for unconfined open water disposal.

The following is a brief summary of the site screening process used in the BHNIP for the disposal of the silty maintenance material. A more detailed description of the site screening process can be found in the draft and final Environmental Impact Report/Environmental Impact Statement (EIR/S) for the Boston Harbor, Massachusetts Navigation Improvement Project. Any changes regarding the acceptability of any of the alternatives from the short list of potential dredged material disposal sites for this maintenance dredging project is described in the following section.

The BHNIP disposal site evaluation process consisted of four phases. Phase 1 of the screening process was limited to identifying "fatal flaws" for sites that precluded further evaluation. Fatal flaws included characteristics such as the location of existing water supply wells, the presence of threatened, endangered, or rare species and/or their critical habitat, sites in or abutting State, local or Federal parks, sites containing a 21E hazardous waste property, and upland sites with less than 15 acres of developable land.

Phase II screening consisted of evaluating potentially acceptable disposal sites against objective criteria relevant to the environment and physiography of the site. Criteria were used that reflected regulatory guidelines and requirements (e.g. Clean Water Act, Coastal Zone Management Act, Massachusetts Wetlands Protection Act, Site Suitability Criteria for Solid Waste Site Assignments, etc.). Phase II criteria were applied to all sites identified as potentially feasible after Phase I screening. Quantitative evaluation of sites was performed for each disposal site category by assigning a numerical score to identify and allow comparison among sites within an individual category to focus attention on the most practicable sites. If a disposal site did not satisfy a particular criterion, a further review was conducted to determine if those concerns could be avoided or reduced through site planning and management or readily mitigated. Data for all sites were examined both quantitatively and qualitatively before determining whether a site should be short-listed.

Phase III screening involved the development of additional site-specific information for short-listed sites from Phase II screening through site visits, aerial photographs, and discussions with appropriate resources agencies. The short-listed sites were re-evaluated against Phase II criteria in light of the additional information resulting in a revised short-list.

In response to comments received during the draft BHNIP EIR/S public comment period, the site screening process was revisited. Additional data collection activities, performed after publication of the DEIR/S, were used to upgrade the data base/criteria upon which the sites would be evaluated. A confirmatory aquatic sampling program was undertaken in October 1994 to assess finfish, benthic and lobster resources at the aquatic disposal sites. Fate and transport modeling to determine sediment load and contaminant transport was performed for all aquatic disposal options. In addition, agency files and resources were used to update and upgrade the information for the land-based sites. This fourth-phase screening process narrowed the list of least environmentally damaging alternatives (LEDA) from 376 sites (and eight treatment technologies) to 23 sites. These 23 sites were then reviewed in terms of cost and capacity as a first step in assessing their practicability. Table 2-1 lists the LEDA sites and their capacity and costs from the Final BHNIP EIR/S.

Table 2-1. List of Least Environmental Damaging Alternatives (LEDA) from the BHNIP FEIR/S

*1995 Dollars

ALTERNATIVE	CAPACITY (CY)	COST*
	UPLAND SITES	
Lined Landfill		
East Bridgewater	200,000	$62
Plainville	200,000	$94
Fitchburg/Westminster	200,000	$108
Coastal Sites		
Squantum Point	210,000	$51
Everett	37,000	$76
Inland Sites		
Woburn	159,000	$69
Wrentham	450,000	$62
	AQUATIC SITES	
Shoreline-Partial Fill		
Amstar	128,000	$62
Cabot Paint	18,000	$362
Little Mystic Channel	373,000	$47
Mystic Piers	98,000	$47
Reserved Channel	86,000	$45
Revere Sugar	186,000	$93
Subaqueous Depressions		
Subaqueous B	562,000	$20
Subaqueous E	591,000	$19
Borrow Pits		
Meisburger 2	1,300,000+	$31
Meisburger 7	1,300,000+	$33
Spectacle Island CAD	1,300,000+	$21
Historic Disposal Site		
Boston Lightship	1,300,000+	$16
Existing Disposal Site		
MBDS	1,300,000+	$16
In-Channel		
Mystic River	742,000	$30
Chelsea River	332,000	$30
Inner Confluence	246,000	$30

A review of these sites in the FEIR/S concluded that most of the LEDA sites were less desirable for the BHNIP because of the high cost or low capacity. The surviving sites were Squantum Point, Little Mystic Channel (partial fill), Mystic River (in-channel), Chelsea River (in-channel), and Inner Confluence (in-channel). Further examination of the environmental impacts and practicability issues for these sites was undertaken to further distinguish among the remaining alternatives.

Squantum Point was eliminated at this stage because of intertidal dredging and wildlife habitat impacts (Table 4-2 in the FEIR/S) and its low practicability for availability, permitting, ease of engineering and logistics (Table 4-7 in the FEIR/S). Of the remaining four sites, use of the Little Mystic Channel would result in filling outside the footprint of the dredging project and a permanent alteration in depth from subtidal to intertidal, both of which were viewed, and would still be viewed currently, as more substantial impacts. In addition, Little Mystic Channel was lower in practicability for most issues (availability, permitability, ease of engineering, and logistics; see Table 4-7 in the FEIR/S), than the in-channel sites.

The FEIR/S assumed the CAD cells would be developed to a depth of approximately 20 feet below the bottom surface. During the BHNIP additional borings indicated that the CAD cells could be dug to deeper depths increasing the capacity for the in-channel CAD cells. The construction of the BHNIP has reduced the remaining CAD cell capacity for the in-channel sites. Also, the results of additional probes and borings indicate that the remaining CAD cell capacity in the Mystic River and Inner Confluence is limited. Therefore, investigations into other in-channel sites, within the dredging footprint, were conducted and are discussed further in Section 2.6 Disposal Sites Evaluated below.

2.4 Disposal Alternatives Identified in the BHNIP FEIR/S for Future Maintenance Dredged Material

The BHNIP FEIR/S identified seven sites as potential disposal sites for future maintenance dredged material. The seven sites include: the Massachusetts Bay Disposal Site (MBDS), Subaqueous B and E, Meisburger 2 and 7, Boston Lightship, and Spectacle Island CAD. See Figure 2-1. The MBDS is an EPA-designated ocean disposal site that is currently open for disposal of material that after a testing protocol has been determined to be suitable for ocean disposal. The Boston Lightship site is a former disposal site. Both sites are located outside State waters and are subject to MPRSA. However, while MBDS is an EPA designated disposal site, the Boston Lightship would need to go through a lengthy site selection process before disposal could be considered and would impact a site that is recovering from disposal. Dredged material that does not meet the ocean disposal criteria would not be allowed at the MBDS or the Boston Lightship.

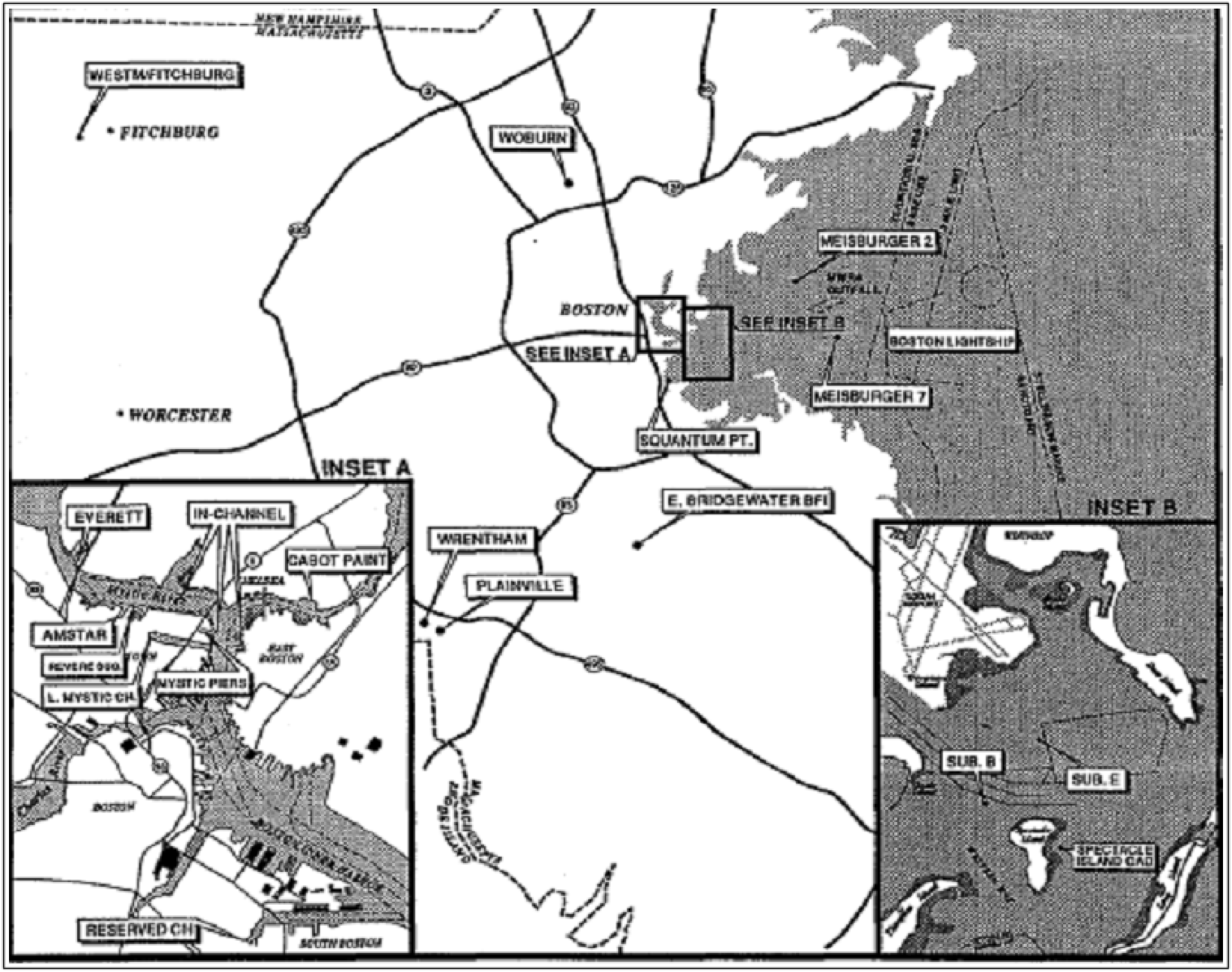


Figure 2-1. BHNIP Short Listed Sites

Subaqueous sites B or E, located in the outer harbor outside the navigation channels, would rely on existing bathymetric conditions to keep disposed sediments in place. These sites would provide 562,000 cy and 591,000 cy of capacity for Subaqueous sites B and E respectively. Silt unsuitable for unconfined open water disposal would be placed in the depressions and capped with sand. ADDAM's model results indicate that the plume created from disposal of the silt at Subaqueous sites B and E could extend a distance of approximately 4,500 feet from the disposal site. On a flood tide this plume could potentially carry contaminants (which may exceed water quality criteria by two times the value) outside the disposal site. Although modeling was not performed for the currently proposed IHMDP project, it is possible that water quality exceedences could occur with this project as well, due to similar sediment characteristics.

The Meisburger sites and the Spectacle CAD sites would require that a subaqueous cell be dug prior to disposal of the silty material and then capped with suitable material such as sand. ADDAM's model results indicate that water quality exceedences would not occur at the offshore Meisburger sites located approximately nine miles from Boston Harbor or at the Spectacle Island CAD site. The Spectacle Island CAD cell site is located east of the Spectacle Island in the shallow subtidal (-10 feet MLW) area and is totally disassociated with the island itself. However, its location near the Boston Harbor Island National Park, which is scheduled to open to the public in 2006, may detract from its suitability as a disposal site. The offshore borrow pit sites, Meisburger 2 and 7, support high benthic productivity and fisheries resources are relatively abundant. Digging a CAD cell at the Meisburger sites would also be more costly due to the greater distance from Boston Harbor and deep water.

The Subaqueous B and E sites, the Meisburger sites and the Spectacle CAD sites are all located in previously undisturbed areas. Therefore these sites are not as desirable as disposal sites in areas that have been previously impacted and the in-channel CAD cells were selected as the preferred disposal site for the unsuitable material.

2.5 Beneficial Use Alternatives

The material to be removed from the IHMDP includes the parent material excavated from CAD cells, the silty maintenance material, and rock. Suggested beneficial uses for the parent material include cap material for confined aquatic dredged material disposal sites, creation of subtidal or intertidal habitat, or for use in a landfill as a liner or as daily or final cap for landfill closures.

The disposal working group raised concerns during the preparation of the BHNIP EIR/S on the ability of the parent material (Boston blue clay) to adequately cap the silty maintenance material. The very plastic nature of the Boston blue clay makes it highly cohesive with limited spreading capabilities. Without additional research, it was assumed that the clay would not spread evenly or consistently across the maintenance material to form a barrier to the aquatic environment or the clay would form "balls" that would sink into the maintenance material. For this reason, use of the clay material as a CAD cap was not recommended. The same concern still exists for the IHMDP; therefore a sand cap is recommended.

The use of the parent material to establish shallow subtidal or intertidal habitat was evaluated for the Reserved Channel and the Little Mystic River Channel in the BHNIP EIR/S. However, since this alternative would disturb a previously undisturbed area it was dropped from further consideration. No additional opportunities for creation of subtidal or intertidal habitat were identified.

The parent material could also be useful for lining landfills or other upland sites that may require liner material. Since the parent material is primarily clay, it is highly impermeable and could be suitable for this purpose. This material could also be useful for daily capping or final closure material at landfills. Before the material could be used at a landfill, a site suitable for dewatering the material in Boston Harbor would need to be identified. Massport owns several lots along the Boston waterfront that are currently vacant (D. Hadden, pers. com.). They are the Medford Street terminal, Mystic Piers 48-49-50, and the Massport Marine Terminal. However, Massport is actively seeking partners to redevelop the terminals in support of Boston Harbor port activities. Restricting land use at the terminals for several years would not be the best use for the port.

Approximately 12,000 cy of rock will be removed from the project area. Potential beneficial uses for the rock include shoreline protection and fish and/or lobster habitat creation. The BHNIP FEIR/S discussed the use of some of the fractured rock as potential shoreline protections along certain areas in and around Boston Harbor, if the rock was found to be physically suitable for such purposes. However, the fractured rock is likely to be of various sizes and not suitable for shoreline protection. Shoreline protection projects generally use a uniform rock size suited for the particular proposed project at hand.

Rock from the President Roads Anchorage area could be used to enhance fish habitat diversity providing structure and depth to areas with little bottom relief. (Rock from the Main Ship Channel is in an area of unsuitable material and will be disposed into a CAD cell). The rocks will vary in size from fairly large stones to very small pieces that can provide interstitial space used for cover and habitat. It would also provide hard substrate for benthic organisms and interstitial space that could increase the diversity and productivity of the existing habitat (niches). A survey was conducted at the Massachusetts Bay Rock Reef Site (MBRRS) located approximately 1 km northeast of the current MBDS, within the confines of the historic interim MBDS or Foul Area Disposal Site (FADS). This survey was conducted approximately 10 years after the disposal of blasted rock from the Central Artery/Third Harbor Tunnel project and the Weymouth Fore River dredging project (SAIC, 2004). The intention of placing rock in a homogenous sandy silt environment was to increase habitat diversity and serve as beneficial use of dredged material. The results of the survey show that the density of encrusting organisms ranged from 5 to 25 percent cover in the cobble areas and 1 to 5 percent in the boulder areas. Geo-tactile fish and invertebrates such as lobsters, crabs, bivalves, and sea stars appear to inhabit the reef. In addition, active and abandoned lobster pots at the site suggest that the reef is a relatively productive fishing area. To further enhance the habitat at the MBDS, the rock removed from the anchorage area will be disposed in an area for hard bottom habitat creation.

There is no known beneficial use for the silt material at this time.

2.6 Disposal Sites Evaluated

Confined Aquatic Disposal Cells

When ranked for direct and indirect impacts as part of the BHNIP, the in-channel CAD cells to dispose of the silty unsuitable material were generally given the lowest impacts for permanent loss, temporary loss, permanent alternation, size of impact, physical changes, subtidal community recovery, water quality effects and effects on marine biota. Other considerations included site stability, downstream impacts, and biological exposure potential. The in-channel CAD cells are located in the navigation channels upstream of the Ted Williams Tunnel; since the tunnel is a permanent constraint against future deepening of the navigation channels upstream of the tunnel. Monitoring of the CAD cells constructed for the BHNIP showed no significant water quality impacts, nor any cap failure. The monitoring results are discussed further in the appropriate subsections of the Environmental Consequences Section of this SEIS/NPC.

Borings and probes were conducted in 2005 for the IHMDP in the Mystic River, and the upper Main Ship Channel to determine subsurface conditions to identify potential CAD cell locations and their design. Based on these geotechnical investigations, it was determined that a single CAD cell constructed in the Main Ship Channel could confine the majority of the dredged material unsuitable for ocean disposal. A “starter cell” for the Main Ship Channel CAD cell would be constructed in the Mystic River channel. A starter cell is a small CAD cell that is dug to confine the dredged material unsuitable for unconfined open water disposal that is removed in developing a larger CAD cell.

Massachusetts Bay Disposal Site

The parent material from the previous BHNIP was disposed at the EPA-designated MBDS. Monitoring of the MBDS has not indicated any significant impacts from previous disposal operations associated with the other Boston Harbor projects. Approximately 1.5 million cy of parent material will be dredged during construction of the IHMDP CAD cells. In addition approximately 400,000 cy of shoal material suitable for ocean disposal will be removed from sections of the Main Ship Channel and disposed at the MBDS.

Rock removed from President Roads Anchorage will be disposed in a suitable pre-designated area at the MBDS. Rocks from previous projects have been disposed at a separate location within the interim MBDS to benefit fish habitat within the disposal site.

2.7 Preferred Design and Disposal Alternatives

The proposed IHMDP involves the dredging of the -35-foot and -40-foot MLLW Main Ship Channel from a point approximately halfway between Spectacle and Castle Island inbound to the Inner Confluence. The upper (-35 foot MLLW) portion of the Reserved Channel and the -40-foot MLLW approach channel to the Navy Dry Dock will also be dredged to their authorized depths. See Figure 2-2. The U.S. Army Corps of Engineers (Corps), Massachusetts Port Authority (Massport) and the Commonwealth of Massachusetts are working together to have

Keyspan Gas remove its gas siphon in the Chelsea River located south of the Chelsea Street Bridge. The continued presence of this pipeline prevented completion of BHNIP dredging in this area. If the line is relocated prior to completion of the IHMDP, the BHNIP maintenance and improvement dredging will be performed in this area to deepen the Chelsea River to its –38 foot MLLW authorized depth. If the line is not removed, then the Chelsea River area will be maintenance dredged to –35 feet MLLW. The material will be disposed into CAD cell C12, located north of the Chelsea Street Bridge, which was previously permitted and constructed for the BHNIP.

The total quantity of maintenance material expected to be dredged is about 1.7 million cy, of which 1.3 million has been found to be unsuitable for unconfined open water disposal. This unsuitable material will be disposed into CAD cells. The remaining 400,000 cy of material is suitable for disposal at the Massachusetts Bay Disposal Site (MBDS). An additional 1.5 million cy of parent material will be dredged to construct the CAD cells. Approximately 350 cy of rock would be removed from the Main Ship Channel and 11,350 cy of rock would be removed from the President Roads Anchorage. Figure 2-3 shows the location of the suitable and unsuitable material. Table 2-2 includes the required and overdepth dredging for this project.

The CAD cells built for disposal of the unsuitable material will be located in the Mystic River and the Main Ship Channel located just below the Inner Confluence. See Figure 2-4. The CAD cells will be dug as deep as possible to maximize storage capacity. Approximately 1.5 cy of parent material will be dredged from the Mystic River and Main Ship Channel to construct the CAD cells. A starter CAD cell will be constructed in the Mystic River to accommodate the unsuitable maintenance material removed from the surface of the CAD cell in the Main Ship Channel. The starter cell will be located just upstream of the Tobin Bridge in the Mystic River, 600 by 700 feet wide, with a depth of 25 feet below the bottom, and will accommodate 400,000 cy of maintenance material. The one large CAD cell constructed in the Main Ship Channel will have a depth of 45 feet or lower with dimensions of 1,100 feet by 600 feet. This CAD cell will be located across from the Mystic Pier heading south in the Main Ship Channel towards the end of Pier 11 and have a capacity of one million cy.

The dredged material that is unsuitable for unconfined open water disposal and placed into the CAD cells will be allowed to settle and consolidate until the material is ready to be capped. After sufficient consolidation has occurred, a three-foot sand cap will be placed on the unsuitable maintenance material to isolate the dredged material placed in the CAD cell from the aquatic environment. The thickness of the cap was selected during the previous BHNIP to isolate burrowing organisms from the unsuitable material underneath and to allow for inaccuracies in construction. Cap material will likely be obtained from an upland commercial sand source, as it was in Phase 1 of the BHNIP. However, in Phase 2 of the BHNIP, suitable sand material was dredged from another Federal project and used for the CAD cell capping. The contractor will have the option to also use suitable material from another dredging project for the CAD cell capping. Disposal of the suitable parent material from the construction of the CAD cells will occur at the MBDS located approximately 20 miles from Boston Harbor (Figure 2-5).

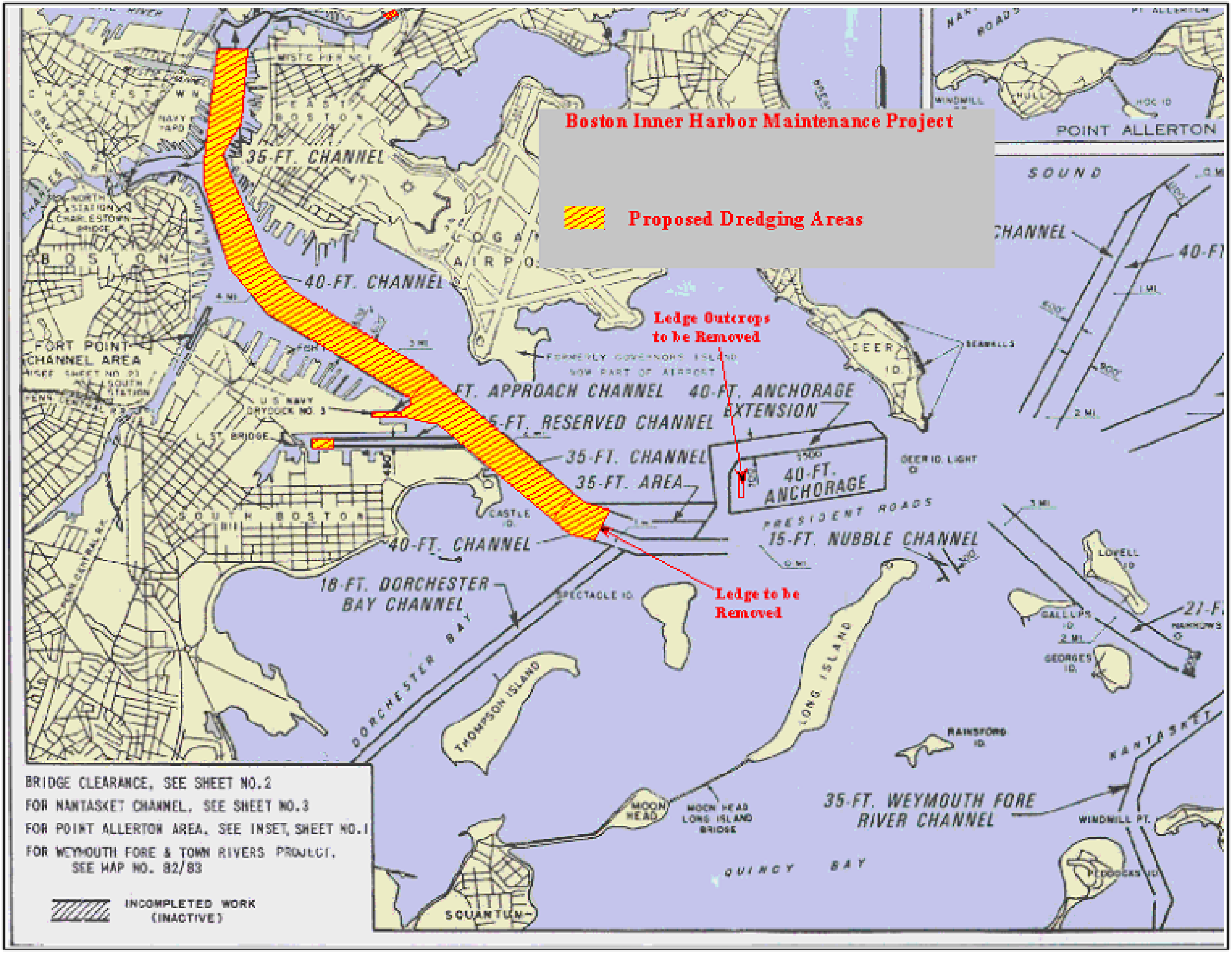


Figure 2-2. IHMDP Dredging Areas

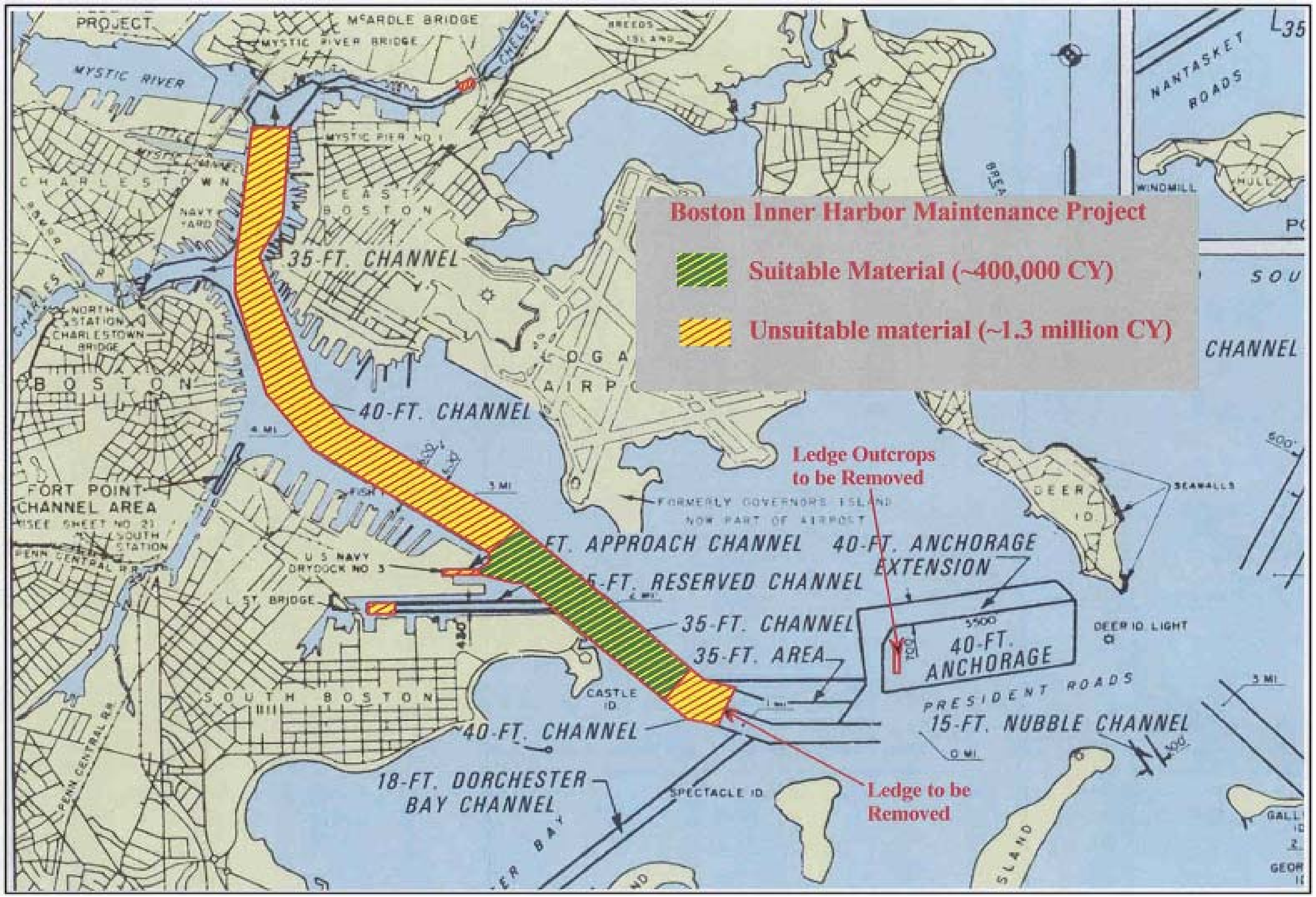


Figure 2-3. Location of Suitable/Unsuitable Dredged Material in Proposed Dredging Footprint

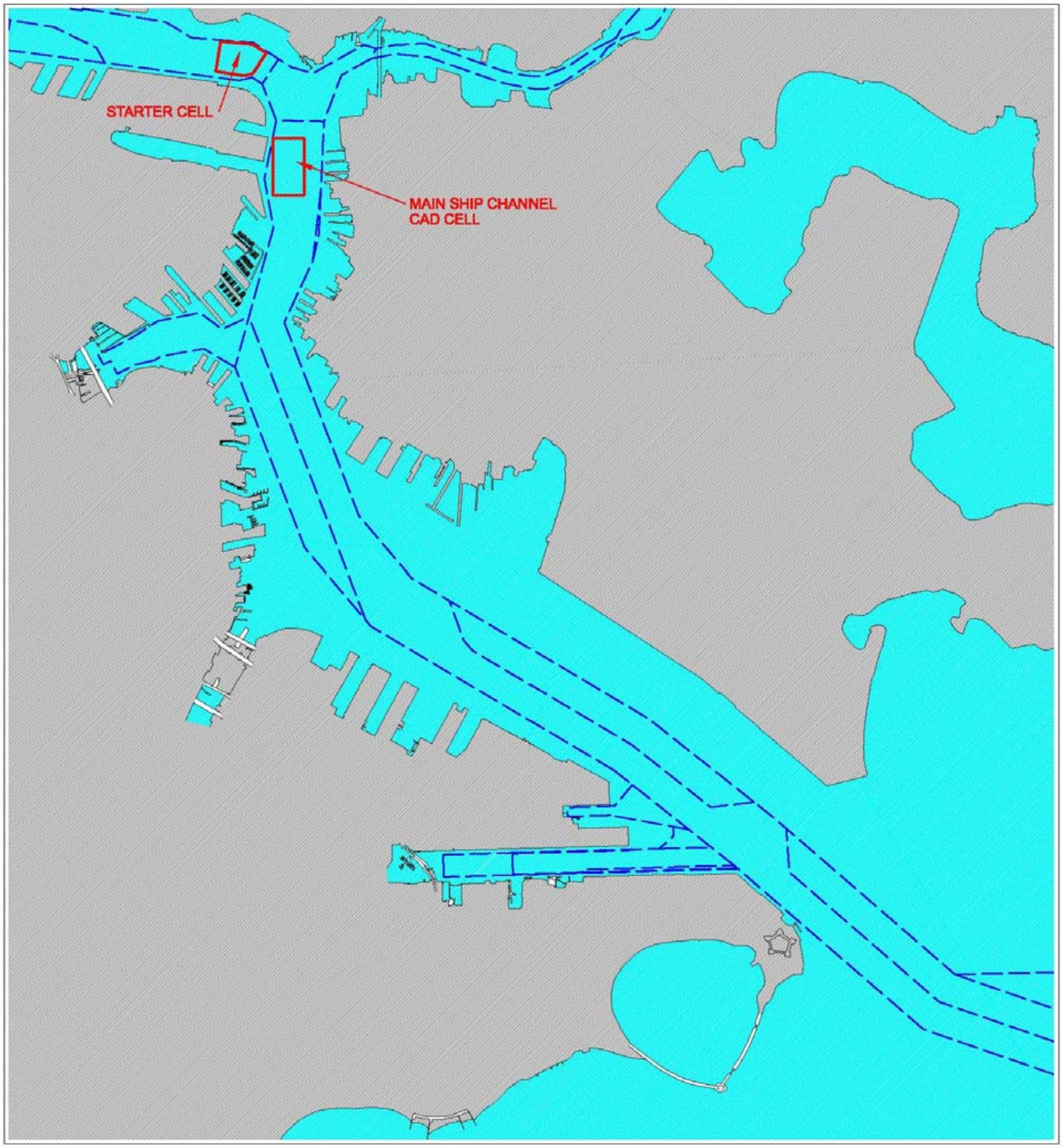


Figure 2-4. IHMDP CAD Cell Locations

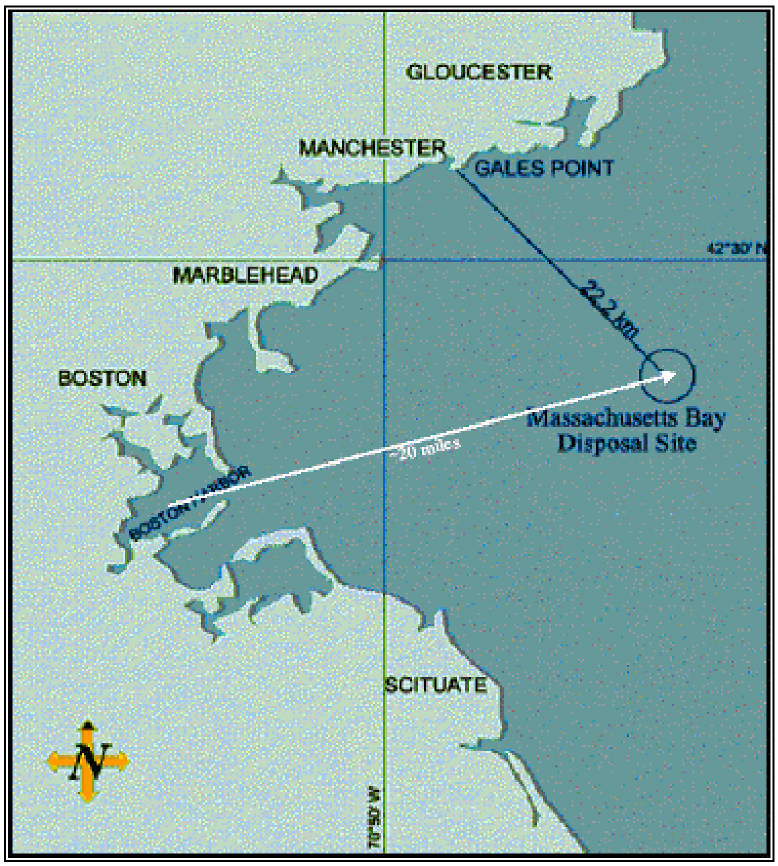


Figure 2-5. Location of Massachusetts Bay Disposal Site

A mechanical dredge will remove the material deemed suitable for ocean disposal from the navigation channel and CAD cells and place the material in a scow for disposal at the MBDS. Material deemed unsuitable for unconfined open water disposal will be removed using an enclosed bucket to minimize impacts to water quality and placed in a scow that will be towed to the CAD cell for disposal. Scows will not be allowed to overflow.

Ledge removed from the President Roads Anchorage area will be disposed in an area of the MBDS to enhance fish habitat. Rock removed from the Main Ship Channel will be disposed in a CAD cell as it is located in an area where dredged material has been deemed unsuitable for unconfined open water disposal. In the BHNIP project, the majority of the rock material was removed with a mechanical bucket. However, the density of the ledge material in this project will likely require blasting to fracture the rock prior to removal with a mechanical bucket.

Dredging will take approximately two years to complete. No dredging or blasting will occur seaward of the Ted Williams Tunnel from December 1 through March 31 to avoid impacts to ovigerous lobsters. See the Mitigation Sections below for additional information.

It is the Corps' policy that the channels of a Federal navigation project should be at authorized depth for 90 percent of the time between dredging cycles. In addition, there is inherent imprecision in the dredging process which vary with the physical conditions (tides, currents, and waves); the dredged material conditions (silt, clay, sand, gravel, rock, etc.); the channel design (depths being dredged, side slopes, etc.); and the type of dredging equipment (mechanical, hydraulic, hopper, etc.). Due to this imprecision, Corps cost estimating and contracting documents recognize that dredging below the authorized project dimensions will occur and is necessary to assure the required depth and width. To balance project construction requirements against the need to limit dredging and disposal to the minimum required to achieve authorized dimensions, a paid or allowable overdepth (including side slopes) is incorporated into the project-dredging prism. Because of the depth of the authorized channel and to avoid more frequent dredging and more frequent environmental impacts, overdepth dredged is allowed under Corps guidelines. New work dredging plans and specifications, where hard materials exist (e.g., dense clays, rock, or manmade materials), shall have a required depth, required overdepth, and allowable overdepth, in order to ensure future maintenance of the project to the authorized dimensions.

To minimize additional environmental impacts, while maintaining the authorized depths within Boston Harbor navigation channels, areas that are at –36 feet MLLW (within the -35 foot navigation channel) and shallow, and –41 feet MLLW (within the -40 foot navigation channel) and shallower, will be delineated and dredged. Within these delineated areas of required dredging, the dredge contractor will be allowed to dredge an additional one foot overdepth. See Table 2-2 for dredge quantities. An additional 1.5 million cy of parent material will be dredged to create the CAD cells, which is not included in the table below.

Table 2-2. Dredge Quantities for IHMDP*

Location	Depth (MLLW)	Total Quantity (Cy)	Unsuitable (Cy)	Suitable (Cy)
Reserved Channel				
Required Depth	-36’	56,509	56,509	
-1’ Overdepth	-37’	19,196	19,196	
TOTAL		*75,705*	*75,705*	
Navy Dry Dock				
Required Depth	-41’	178,388	53,445	124,943
-1’ Overdepth	-42’	28,549	8,014	20,535
TOTAL		*206,937*	*61,459*	*145,478*
Main Ship Channel				
Required Depth	-36’ & -41’	843,270	706,052	137,218
-1’ Overdepth	-37’ & -42’	568,001	470,008	97,993
TOTAL		*1,411,271*	*1,176,060*	*235,211*
Rock				
Required Depth	-42’	165	0	165
-2’ Overdepth	-44’	11,537	350	11,187
TOTAL		*11,702*	*350*	*11,352*
ENTIRE PROJECT				
Required Depth		1,078,332	816,006	262,326
Overdepth		627,373	497,658	129,715
TOTAL MATERIAL		***1,705,615***	***1,313,574***	***392,041***

* Maintenance dredging the Chelsea St. Bridge area to the required depth of –36’ MLLW with one-foot overdepth would involve the removal of an additional 9,400 cy of material. Dredging Chelsea St. Bridge area to the BHNIP approved required depth of –39’ MLLW with one-foot overdepth would necessitate the removal of an additional 23,000 cy of material.

3.0 Affected Environment

3.1 Location

Boston Harbor is located on the coast of Massachusetts between Cape Cod and the New Hampshire border. The harbor is formed by the outlying islands and the peninsula areas of Winthrop to the north and Hull to the south. The harbor is the largest port in New England covering approximately 47 square miles. The harbor supports shipping, commercial and industrial businesses, fishing and recreational interests.

3.2 Water Quality

<u>Boston Harbor</u>

Boston Harbor was once one of the most contaminated estuaries in the United States. The shallow harbor was the recipient of pollutants and excessive nutrients from streams and rivers in eastern Massachusetts. Decades of urban runoff and an antiquated sewage treatment plant resulted in serious water quality and human health concerns (Battelle, 2000).

In 1985, a Federal court order was issued to the Massachusetts Water Resources Authority (MWRA) to construct a new sewage treatment plant and related facilities to address the water quality and human health concerns. These improvements occurred gradually from 1988 to 2000 (MWRA, 2004). In 1988, sewage scum was no longer discharged into the harbor but placed into a landfill instead. Sludge discharges into the harbor from the old Deer Island and Nut Island treatment plants ended in December of 1991. The beginning of secondary treatment in 1997 marked a dramatic decrease in biological oxygen demand (BOD) and continuing declines of bacteria, solids, nitrogen and phosphorus. The new ocean outfall diffuser came on line in September 2000, beginning the discharge of effluent through a 9.5 mile outfall in Massachusetts Bay.

In addition to these major construction projects, MWRA addressed the problem of combined sewer overflows (CSOs), which discharge a mixture of stormwater runoff and sewage directly into the harbor during heavy rainstorms.

Since effluent discharges to the harbor have decreased, water quality has improved and the water quality classification in the inner harbor and President Roads area of Boston Harbor has improved from SC to SB. Class SB waters are designated as a habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas they shall be suitable for shellfish harvesting with depuration (Restricted Shellfish Areas). These waters shall have consistently good aesthetic value. Dissolved oxygen levels shall not be less than 5.0 mg/l unless background conditions are lower. Waters approved for restricted shell fishing shall not exceed a fecal coliform median or geometric mean MPN of 88 per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml. In addition, these waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class. These waters shall also be free from oil, grease and petrochemicals that produce a visible film on the surface of the water, impart an oily taste to the water or an oily or other undesirable taste to the edible portions of aquatic life, coat the banks or bottom of the water course, or are deleterious or become toxic to aquatic life.

The increase in water quality within Boston Harbor should create more favorable conditions for the return of more typical flora and fauna of a healthy estuary.

Massachusetts Bay Disposal Site

Water quality at the Massachusetts Bay Disposal Site (MBDS) has not been affected by the relocation of effluent discharge from Boston Harbor to Massachusetts Bay. Three dimensional circulation models and water quality monitoring has not shown any adverse impacts to the MBDS (USGS, 2005).

Temperature and Salinity

Boston Harbor

Water temperature and salinity was measured for seven years (from 1993 to 1999) in Boston Harbor to characterize the baseline conditions prior to the discharge of wastewater from the new outfall (Taylor, 2001). Sampling stations were located in the North Harbor (north of Long Island and in the project area) and in the South Harbor region (south of Long Island and outside the project area). The average water temperature was 9.6 ^{o}C (Taylor, 2002a). Highest water temperature in the summer averaged approximately 20^{o}C and showed very little variation over the years. The minimum temperature did, however, show a slight increase from the winter 1993/1994 to the winter of 1998/1999. In general the water temperature for the two regions in Boston Harbor, the North Harbor and the South Harbor, were similar (Taylor, 2001).

Variations for salinity within a year were considerable for the harbor (Taylor, 2001). Salinity ranged from about 26 ppt to 33 ppt. Average annual salinity levels in the North Harbor, where the project area is located, were consistently lower than the average annual salinity levels in the South Harbor (Taylor, 2001). Average salinity did increase very slightly after the interisland transfer of wastewater from NITP to DITP from 29.8 to 29.9 ppt in the North Harbor and 30.8 to 30.9 in the South Harbor (Taylor, 2002a). It might be expected that salinity levels would decrease in the Inner Harbor as one moves closer to the mouth of the three rivers (Charles River, Mystic River and Chelsea River) discharging into Boston Harbor. As no significant trends in water temperature or salinity were observed in the harbor as a whole or in either the two regions (North Harbor [where the project is located] or South Harbor), this suggests the trends were not the result of long-term trends in freshwater flows or water temperature (Taylor, 2001).

Massachusetts Bay Disposal Site

In winter, the water column in Massachusetts Bay is well-mixed. Stratification occurs later in the spring due to the increased spring freshets that decrease the surface salinity. This increase in stratification separates the bottom and top layers of the water column, effectively reducing the availability of nutrients to the surface from the bottom and oxygen to the bottom layer (Libby *et al*., 2004).

The summer is generally a period of strong stratification, depleted surface water nutrients, and a relatively stable-mix of phytoplankton dominated by microflagellates (Libby *et al*., 2004). Higher temperature also has a direct effect on dissolved oxygen levels by increasing respiration rates (Libby *et al*., 2004).

In the fall, strong winds and cooling temperatures promote mixing of the water column (Libby *et al*., 2004). The lowest bottom water dissolved oxygen levels are observed just prior to the overturn of the water column in October (Libby *et al*., 2004). By early winter, the water column is well-mixed and reset to winter conditions.

Water Column Turbidity

Turbidity refers to how clear the water is. The greater the amount of total suspended solids (TSS) in the water, the murkier it appears and the higher the measured turbidity. Turbidity is caused by the suspended and dissolved matter, such as clay, silty, finely divided organic matter, plankton and other microscopic organisms, organic acids, and dyes (ASTM International, 2003, *in* Wilde, F.D., 2005). Natural causes of turbidity include runoff, phytoplankton and zooplankton, and minute fragments of dead plants. Anthropogenic sources of turbidity include runoff from agricultural fields, wash from construction sites and urban areas, shoreline erosion from heavy boat traffic, dissolved nutrients released in treated wastewater, and organics released by sewage treatment plants. Although turbidity is not an inherent property of water such as temperature or pH (Davies-Colley and Smith, 2001, *in* Wilde, F.D., 2005), it is an indicator of water body health.

High levels of turbidity, outside the normal range of turbidity levels, over long periods of time can be a concern for the health and productivity of the estuarine ecosystem for several reasons. Turbid waters can decrease light penetration into the water, thereby lowering photosynthetic activity and reducing the area available for submerged aquatic plants to grow. Algae can greatly limit light penetration and can limit primary production to the uppermost layers of water. This can cause invertebrate population decline (caused by fewer photosynthetic organisms available for food). This in turn can affect fish population decline (caused by fewer invertebrates available for food). Suspended material in large quantities can foul the filter-feeding systems of certain estuarine animals. Particles may accumulate on the gills of fish and inhibit breathing. High levels of turbidity can hinder aquatic predators from spotting and tracking down prey. Dissolved oxygen can be depleted if turbidity is largely due to organic particles.

Water clarity has improved in the harbor since 1993 (MWRA, 2004). The water clarity gradient shows an increase from west to east. Water is more turbid toward the river and shallow margins of the harbor and clearer toward the mouth of the harbor and bay. Secchi disk measurements (a white disk lowered into the water column until it disappears) showed that up until July 1998 Secchi disk depths were generally greater than 6.6 feet over most of the harbor, but were noticeably shallower around the Nut Island outfalls and in Dorchester Bay. After closing the NITP in July 1998, Secchi disk depths increased by more than three feet near the old NITP outfalls. In other parts of the harbor, the water clarity only increased 8 inches to two feet or near the DITP, not at all.

Dissolved Oxygen

Dissolved oxygen (DO) in marine waters is essential for most healthy aquatic life. If levels are too low it can be a sign of pollution. Healthy conditions for aquatic life exist when dissolved oxygen are above 5.0 mg/L. Concentrations between 5.0 mg/L and 3.5 mg/L are generally healthy, except for the most sensitive species. When concentrations fall below 3.5 mg/L, conditions become unhealthy. The most severe effects occur if concentration levels fall below 2.0 mg/L, even for short periods of time (EPA, 1997).

Monitoring of DO levels in Boston Harbor show that, even before the MWRA improvements were implemented, DO levels were high enough to support healthy marine life (MWRA, 2004). With the completion of the “the MWRA work”, DO levels have remained relatively stable. This is due to the tidal flushing of the harbor that results in a well-mixed water column. Monitoring has shown that even at the end of summer, when DO levels are typically at their lowest, concentrations are still high. DO levels increase with distance from the shoreline and are lowest in the Inner Harbor and the mouths of rivers. DO levels in the harbor range from 4.9 mg/L in the Mystic River/Inner Harbor, to 8.1 mg/L in the area south of Long Island (MWRA, 2004).

Nutrients

Nutrients such as nitrogen and phosphorus are necessary in a productive marine ecosystem. However, too much nitrogen, especially in the form of ammonia, can fuel and stimulate the excessive overgrowth of algae and seaweed. The dense algae blooms cloud the water and shade the bottom. When the algae die and settle to the bottom, they are decayed by bacteria that can use up oxygen. Oxygen is necessary for aquatic organisms to feed, grow and live. In extreme conditions, some organisms may suffocate and die, while others flee the hypoxic (low dissolved oxygen level in the water) zones. Dense algae blooms can prevent enough light from reaching shallow water bottoms to support the growth of submerged aquatic vegetation, an important habitat for shellfish and juvenile fish (EPA, 1997).

Nutrient load has improved significantly since the discharges from the NITP ended and discharges from the DITP were moved in September 2000 to the diffuser offshore. A very large decrease in ammonia at the NITP outfall site was noted after discharges from NITP ended. In addition, the average concentrations of dissolved inorganic nitrogen (5.5 $u$mole 1^{-1}) and dissolved inorganic phosphorus (0.73 $u$mole 1^{-1}) decreased 55% and 31% respectively after the diffuser came on-line (Taylor, 2002b). Now ammonia at the NITP and DITP sites shows a typical, low seasonal cycle seen in healthy estuaries (MWRA, 2004).

3.3 Physical Environment

Geology

There has been no change in the geology of Boston harbor since the BHNIP EIS.

Physical Oceanography

Boston Harbor

The harbor is relatively shallow with an average depth of about 15 feet, and is well flushed by strong tides. The water within Boston Harbor is replaced by Massachusetts Bay and river waters within five to seven days (MWRA, 2004). USGS (2005) computer modeling show the deep channels at the mouth of the harbor to be more rapidly flushed than the Inner Harbor and shorelines of Boston Harbor.

The dominant currents in the harbor are tidal in origin, although wind driven currents occur during storms. Freshwater flow discharges from the Mystic, Charles, and Chelsea Rivers generally overlie the more dense seawater flows from the tides. Freshwater flows average 350 to 500 cubic feet per second (cfs) in the summer. Tidal input are orders of magnitude greater with flows averaging 320,000 cfs for a six hour period and volumes ranging from 10.6 billion gallons at low tide to 179.9 billion gallons at high tide (Metcalf and Eddy, 1976; and MDWPC, 1986). At the mouth of the Inner Harbor near Castle Island, the recorded mean tide range is 9.4 feet and the spring tide range is 10.9 feet (NOAA, 1999). The mean tide level is 5.0 feet. The fastest tidal currents in Boston Outer Harbor occur in the deep ship channels (up to 1.4 knots) during spring tides in the southern lane of the Main Ship Channel (Corps/Massport, 1994).

Massachusetts Bay Disposal Site

The Massachusetts Bay Disposal Site is located in Stellwagen Basin on the western edge of Stellwagen Bank in Massachusetts Bay. Massachusetts Bay is a semi-enclosed embayment surrounded by the Boston metropolitan region in the north and west, and Cape Cod in the south while it is open to the Gulf of Maine in the east. It is about 60 miles long and 30 miles wide, and has average depth of 115 feet. Stellwagen Basin is the only deep basin in Massachusetts Bay with a depth up to 300 feet. It is bounded in the east by Stellwagen Bank with the shallowest depth of about 65 feet, and is connected to the Gulf of Maine through the North Passage off Cape Ann and the South Passage off Race Point (Jiang and Zhou, 2004a).

Previous studies have indicated that the circulation in Massachusetts Bay/Cape Cod Bay varies in response to short and long-term local and remote forcing (Geyer *et al*., 1992; Signell, *et al*., 1996 in Jiang and Zhou, 2004a). The local and remote forces include: 1) wind stresses and heat fluxes at the sea surface, 2) tides and mean surface slopes at the open boundary, and 3) freshwater runoff including outfall effluents. A counterclockwise circulation characterizes the yearly-mean current in Massachusetts Bay/Cape Cod Bay. Tides are semi-diurnal. Tidal currents vary from 10 cm s^{-1} in Stellwagen Basin, to 50 cm s^{-1} off the tip of Cape Cod. In most of Massachusetts Bay, the flow-through flushing tie for the surface waters ranges from 20 to 45 days (USGS, 1998).

A modeling study conducted for the MWRA indicates pronounced seasonal variation in the circulation pattern (Jiang and Zhou, 2004b). In western Massachusetts Bay, the currents are strongly driven by surface winds. In winter and spring seasons, northerly winds drive a southward coastal current thus creating a counterclockwise circulation that is consistent with the annual mean pattern (Geyer et al., 1992 in Jiang and Zhou, 2004a). In summer and early fall, predominant southwest winds produce offshore Ekman transport and coastal upwelling, which induce an overall northward coastal current along the upwelling front near the western coast, thereby reversing the counterclockwise circulation. This is confirmed by the moored Acoustic Doppler Current Profiler (ADCP) current measurements at the U.S. Geological Survey buoys (Butman *et al*., 2002) and the MWRA modeling study (Jiang and Zhou, 2004b). The coastal upwelling and downwelling have also been discussed in previous studies (e.g., Geyer, *et al*., 1992; HydroQual and Signell, 2001 *in* Jiang and Zhou, 2004a).

Sediment Characteristics

Sedimentary environments in the affected environment, including Boston Harbor and Massachusetts Bay, have been mapped and interpreted from an extensive collection of side scan sonar records and supplemental marine geologic data gathered by Knebel and Circe (1995). While this area represents a relatively complex sedimentary environment, Knebel (1993), and Knebel and Circe (1995) identified three primary sedimentary environments that show direct correlation with processes of erosion, deposition, and sediment reworking. Figure 3-1, adapted from work presented by Knebel (USGS, 1999a) and available on the United States Geological Survey (USGS) web site (http://pubs.usgs.gov/of/of99-439), provides an overview of the sedimentary environments recognized in the area.

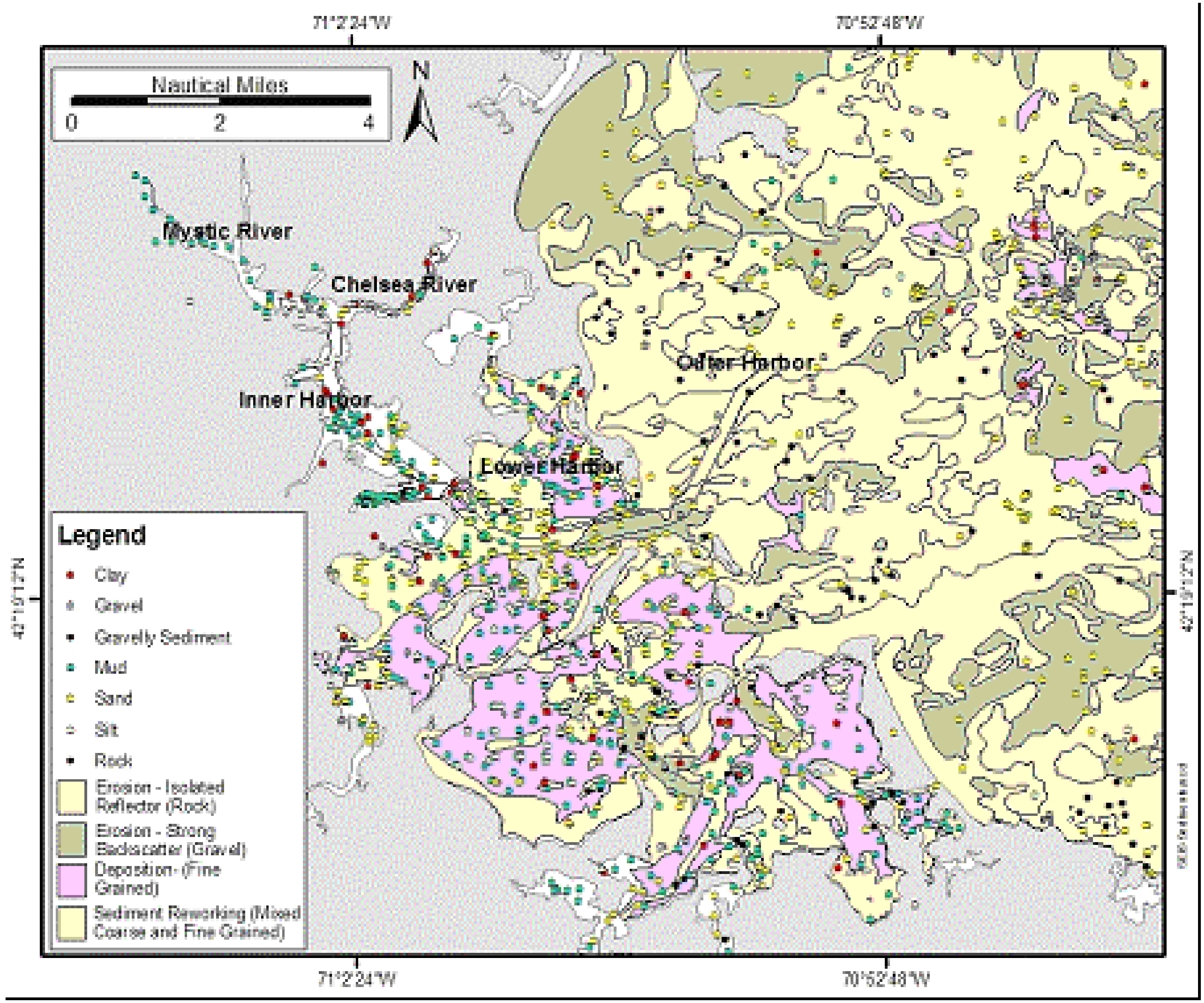
> ***Side scan Sonar*** is a technique using ultrasonic sound to visualize the structure of the seafloor using backscatter images. Bright areas on the backscatter images represent hard objects like rock that reflect sound readily (*i.e.*, Strong Backscatter) while dark areas showing weaker reflectance represent soft objects like silt which absorb sound and reflect it poorly.

Erosional marine environments consist of subtidal, exposed bedrock, glacial drift, and coastal-plain rocks. Non-depositional areas consist of coarse-grained lag deposits. These areas contain bottom types ranging from boulder fields to gravelly sands and occur in areas of high energy. Inside the harbor, erosional areas were found near mainland and insular shorelines, harbor approaches, and over scattered knolls and ridges. Subbottom profile data acquired in these areas show bedrock and/or glacial till outcropping on the seafloor. As depicted on Figure 3-1, erosional/non-depositional environments are isolated to the southern shoreline regions of the Inner Harbor, but are predominant across the Outer Harbor.

Depositional environments are areas blanketed by muddy sands and/or muds that have accumulated under predominantly weak bottom current conditions. The sediments in depositional areas are fine-grained and contain relatively high concentrations of organic matter. They occupy a large portion of Boston Harbor.

Sediment reworking environments are areas where bottom currents fluctuate considerably in strength causing sediments in the areas to be intermittently eroded and deposited. Reworked areas are characterized by sandy-gravels to mud. Environments interpreted as sediment reworking are less common in the harbor than the preceding two types of environments mentioned.

Additional side scan and sub-bottom profile analyses were performed within the Boston Harbor navigation channel in 2002 (Corps, 2003a). Limited side scan data in the Inner Harbor and Mystic and Chelsea Rivers, in conjunction with the grain-size data shown on Figure 3-1, appear to indicate that the sedimentary environments in these areas consist predominantly of silt, clay, and mud, which is characteristic of a depositional area. This estuarine environment, because of its protected nature, low wave climate, and large supply of sediments, is an effective trap for fine-grained material. Isolated areas of gravel were noted near the mouth of both the Mystic and Chelsea Rivers (Figure 3-1).



Source: USGS, 1999a
Note: Bottom type locations are approximate.

Figure 3-1. Sedimentary Environments and Sediment Bottom Type in Boston Harbor and Massachusetts Bay

<u>Sediment Contamination and Suitability Testing</u>

Sediments can contain solid contaminants as well as contaminants from the water column that are absorbed onto the soil particles, that in essence can contain a memory bank of contaminant inputs into urban waterways (USGS, 1999b). To help understand the distribution of sediment contaminants and their sources, transport and other processes, the USGS (1999) assembled a database of all available sources of information on chemicals in sediments of the Boston Harbor area. According to the 1993 sediment database (USGS, 1999b), median values for metal contaminants such as zinc, lead, chromium, and copper ranged from four to more than 20 times estimated background levels. Arsenic and silver as well as other metals also showed concentrations at levels higher than background levels. Organic contaminants such as polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and pesticides like DDT and chlordane are also widely distributed in the sediments, although their proportions in the sediment fall into smaller toxic ranges (USGS, 1999b).

As might be expected, contaminant concentration levels in general are higher in the Inner Harbor, where they are closest to point sources than samples in the Outer Harbor. Local variability in contaminant concentrations can also be more extreme in the Inner Harbor, a condition related partly to proximity to point sources of contaminants (USGS, 1999b).

A tiered approach to testing is used to reach a decision on whether the material from a dredging project is suitable or not for unconfined open water disposal. The initial tiers (Tier I and Tier II) use available information, and physical and chemical testing for determining potential environmental impact of the dredged material in question. For some dredged material with readily apparent potential for environmental impact (or lack thereof), information collected in the initial tiers may be sufficient to make a decision. However, more extensive evaluation in Tier III (toxicity and bioaccumulation tests) and, in rare cases, Tier IV (long-term bioassay/ bioaccumulation and/or risk evaluation) testing may be needed for materials with less clear potential for impact or for which the information is inadequate. These tests are conducted in accordance with the EPA and Corps national guidance testing manuals (EPA and Corps, 1991, 1998) and the Regional Implementation Manual for open and ocean water dredged material disposal (EPA and Corps, 2004) described above in Regulations Governing Dredged Material.

To determine suitability of sediment in the channels of Boston Harbor, sampling was conducted according to EPA and Corps national guidance. Sediment cores were taken from 49 locations within Boston Harbor between April 1999 and April 2004 to characterize the dredged material. Samples were taken from three distinct locations: 1) the 35-foot and 40-foot deep MLLW Main Ship Channel (MSC) from west of Spectacle Island to the Inner Confluence; 2) the approach channel to the Navy Dry Dock; and 3) the upper Reserved Channel. Only those samples that are in the project area will be discussed. See Figure 3-2 for sample locations. New cores were collected and composited. The composites were then analyzed for grain size, total organic carbon (TOC), bulk sediment chemistry, a suspended particulate assay, a 10-day bioassay, and/or a 28-day bioassay/ bioaccumulation test, as needed. The results of these tests were used to determine suitability of the dredged material for ocean and open water disposal.

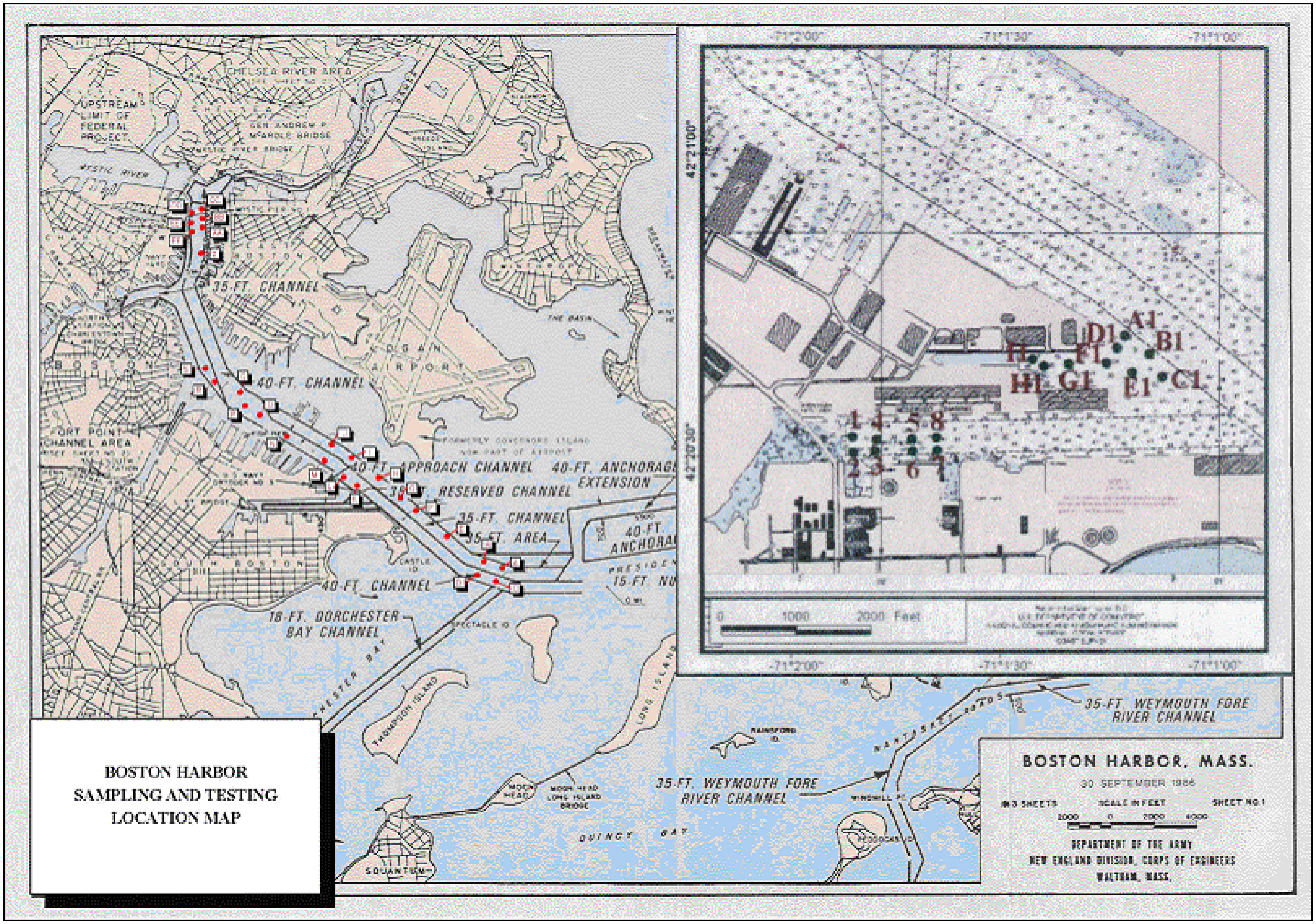


Figure 3-2. Sediment Sampling Locations

A brief explanation of the biological tests is described as follows:

- *Solid Phase (Benthic) Acute Toxicity*: Sediment toxicity (mortality) was assessed through a direct 10-day exposure of one species of marine amphipod, the *Ampelisca abdita*, to the sediment.
- *Suspended Particulate Phase*: Water column toxicity was assessed through exposures of three species of organisms (96-hour exposure of a vertebrate *Menidia beryllina*, 96-hour exposure of a crustacean *Americamysis bahia*, and a 72-hour exposure of a sea urchin larvae *Arbacia punctulata*) to the suspended particulate phase (SPP) of the sediment. If mortalities were greater than 50% in any of the dilutions, than LC_{50} values were estimated. The significance of these estimates is based on the likelihood of 0.01 of these concentrations existing at the edge of the mixing zone after disposal operations, after allowance of four hours for initial mixing.
- *Bioaccumulation*: Statistical analyses were performed using results from the solid and suspended particulate phase toxicity test data to determine whether acute toxicity was observed relative to the reference sediment. Tissue chemistry data for *M. nasuta* and *N. virens* were statistically evaluated to determine whether significant bioaccumulation of contaminants of concern was present in tissues exposed to the test sediment composites relative to those exposed to the MBDS reference sediment.

A summary of the grain size analysis, bulk chemistry analysis and/or biological tests for each area of the proposed maintenance dredging project in Boston Harbor is described below. The results of these test results are found in reports prepared under direction of the Corps by Battelle (2001, 2002, 2004a, 2004b, 2004c) and GEI (2004).

The following table (Table 3-1) identifies the composite, the composite location and collection date(s) for each sample in Boston Harbor.

Table 3-1. Sediment Composite Locations and Collection Date(s)

Composite	Location	Date(s) Collected	Composite	Location	Date(s) Collected
AB	35' MSC	2000/2001	BBCC	40' MSC	2000/2001
CD	40' MSC	2000/2001	DDEEFF	40' MSC	2000/2001
EFG	35' MSC	2000/2001	1,2.3,4	Reserved C.	2001
HIJ	35' MSC	2000/2001	5,6,7,8	Reserved C.	2001
KL	40' MSC	2000/2001	A1B1C1	Navy Dock	2001
MN	40' MSC	2000/2001	D1E1F1	Navy Dock	2001
O	40' MSC	2000/2001	G1H1I1	Navy Dock	2001
PQ	40' MSC	2000/2001	LL	35' MSC	2004
RS	40' MSC	2000/2001	MM	35' MSC	2004
ZAA	40' MSC	2000/2001	NN	35' MSC	2004

Grain Size – As expected, grain size results indicate that the maintenance material in the navigation channels is mostly black silty fine-grained material. Total organic carbon levels are also high. Table 3-2 provides a summary of the results.

Table 3-2. Grain Size and TOC Results from the Inner Harbor

Sample	Site*	Gravel (%)	Coarse Sand (%)	Med. Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	TOC (% dry wt.)
AB	MSC	3.74	0.82	2.86	21.37	26.70	44.50	2.06
CD	MSC	0.00	0.31	0.66	14.53	40.00	44.50	2.91
EFG	MSC	0.00	1.03	0.56	12.58	33.83	52.00	2.95
KL	MSC	0.00	0.00	0.64	10.46	36.90	52.00	2.87
MN	MSC	0.00	0.08	0.79	5.32	38.80	55.00	2.79
O	MSC	0.00	0.15	0.59	3.59	38.66	57.00	2.80
PQ	MSC	0.00	0.11	0.63	3.17	35.17	60.00	2.49
ZAA	MSC	0.00	0.32	1.05	14.46	33.17	51.00	4.35
DDEEFF	MSC	0.00	0.13	0.56	8.91	40.90	49.50	3.93
1,2,3,4	Resrv	0.00	0.00	0.59	3.48	25.92	70.00	4.18
5,6,7,8	Resrv	0.00	0.39	1.43	11.52	25.16	61.50	4.04
A1B1C1	NDD	0.00	0.27	0.91	9.98	29.35	59.50	2.73
D1E1F1	NDD	0.00	0.71	0.24	5.35	28.70	65.00	2.94
G1H1I1	NDD	0.00	0.00	0.45	2.62	27.44	69.50	3.76
LL	MSC	0.00	0.00	0.36	13.11	39.40	47.13	2.69
MM	MSC	0.00	0.05	0.36	7.34	33.51	58.75	2.41
NN	MSC	0.00	0.09	0.05	0.23	26.60	73.03	0.11

*MSC = Main Ship Channel; Resrv = Upper Reserved Channel; NDD = Navy Dry Dock

Sediment Chemistry – The following metals were tested in the sediment: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn). The results are listed in Table 3-3. The sediments were also tested for polychlorinated biphenyls (PCBs), pesticides, and polycyclic aromatic hydrocarbons (PAHs), see Table 3-4. The tested metals were detected in all samples at levels greater than the Target Detection Limit, with samples PQ and G1H1I1 generally having slightly higher concentrations relative to all other sediments. Metals levels were higher than the MBDS reference sample

With few exceptions (e.g. aldrin), all target PCBs and pesticides were detected in all of the sediment composites at levels greater than the Target Detection Limits. Total PCB ranged from 325 ppb at composite NN to 2,961 ppb at DDEEFF. DDTs and chlordanes were the most common chlorinated pesticides detected in the sediments at levels above the Target Detection Limit (2.0 ppb). PCBs and pesticides were generally higher than the MBDS reference sample.

PAHs were detected above the Target Detection Limits in all sediment composites, with fluoranthene and pyrene being the most abundant PAHs in every sample tested. Concentrations of PAH were considerably lower in the reference site sample (MBDS) compared to harbor composite samples.

Table 3-3. Sediment Metals Concentration Levels (ppm)

Sample	Site*	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
AB	MSC	9.57	1.45	153	71.3	0.77	25.6	85.7	149
CD	MSC	9.29	2.29	246	144	1.07	35.3	125	248
EFG	MSC	8.22	2.18	190	97.6	1.45	26.4	102	173
KL	MSC	11.9	3.15	267	166	1.09	44.0	133	290
MN	MSC	13.4	3.06	263	168	1.23	42.1	149	285
O	MSC	17.7	3.27	273	150	1.15	43.2	141	277
PQ	MSC	26.5	3.76	232	201	8.93	45.9	839	948
ZAA	MSC	23.4	4.05	332	204	1.75	38.8	271	428
DDEEFF	MSC	20.9	3.28	264	230	2.57	46.2	276	453
1,2,3,4	Resrv	12.7	3.79	221	187	1.16	49.9	163	264
5,6,7,8	Resrv	13.0	3.93	224	180	1.26	42.0	172	259
A1B1C1	NDD	11.6	2.87	232	126	1.12	33.2	135	224
D1E1F1	NDD	12.5	2.76	231	128	1.45	34.8	149	234
G1H1I1	NDD	16.2	4.51	308	445	3.25	45.6	216	406
LL	MSC	13.4	2.12	226	154	1.01	36.0	120	256
MM	MSC	18.5	2.17	228	119	0.95	39.3	113	255
NN	MSC	22.1	1.50	191	103	0.94	38.5	111	262

*MSC = Main Ship Channel; Resrv = Upper Reserved Channel; NDD = Navy Dry Dock

Table 3-4. PCB, DDT and PAH Sediment Summary Data (ppb dry)

Sample	Site*	Total PCB	Total DDT	Total PAH
AB	MSC	347		5,947
CD	MSC	542		7,915
EFG	MSC	512		6,250
KL	MSC	526		6,717
MN	MSC	504		7,337
O	MSC	685		10,430
PQ	MSC	677		7,782
ZAA	MSC	1273		22,899
DDEEFF	MSC	2961		20,311
1,2,3,4	Resrv	605		13,291
5,6,7,8	Resrv	742		15,013
A1B1C1	NDD	531		7,087
D1E1F1	NDD	472		8,408
G1H1I1	NDD	1148		13,569
LL	MSC	392	26.2	7,700
MM	MSC	417	38.5	7,430
NN	MSC	325	23.1	7,950

*MSC = Main Ship Channel; Resrv = Upper Reserved Channel; NDD = Navy Dry Dock

Biological Tests – The solid phase amphipod test is used to determine if the material meets the limiting permissible concentration (LPC) for benthic toxicity. If the organism survival in the test sediment and the reference site sediment is statistically significant and >20%, then the dredged material is not considered suitable for unconfined open water disposal. Composites O, PQ, ZAA, DDEEFF, 1,2,3,4, 5,6,7,8, G1H1I1, MM, NN did not pass the 10-day acute solid phase amphipod test and is therefore not suitable for ocean water disposal. See Table 3-5 for the solid phase amphipod test results.

Table 3-5. Statistical Significance of 10-day Acute Solid Phase *Amphipod* Tests

Sample	Statistically Significant Difference from MBDS[1]
AB	Yes
CD	Yes
EFG	No
KL	Yes
MN	Yes
O	**Yes**[2]
PQ	**Yes**
ZAA	**Yes**
DDEEFF	**Yes**
1,2,3,4	**Yes**
5,6,7,8	**Yes**
A1B1C1	No
D1E1F1	No
G1H1I1	**Yes**
LL	Yes
MM	**Yes**
NN	**Yes**

[1] Significant difference identified by ANOVA and Dunnett's test ($\alpha = 0.05$).
[2] For treatments shown in boldface type, the difference in mean survival between the treatment and the reference sediment was statistically significant and >20%.

SPP - Three water column tests were conducted in support of the Boston Harbor study: two 96-hour exposures using a vertebrate (*Menidia beryllina*) and a crustacean (*Americamysis bahia*) and a 72-hour using larvae of the Eastern purple urchin (*Arbacia punctulata*). If mortalities were greater than 50% in any of the dilutions, LC_{50} values were estimated. The significance of these estimates is based on the likelihood of 0.01 of these concentrations existing at the edge of the mixing zone after disposal operations, after allowance of four hours for initial mixing.

Results of all three suspended particulate phase (SPP) tests are summarized below. The SPP samples identified as EFG, 5,6,7,8 and G1H1I1 had a negative impact on the 96-hour survival of *Americamysis bahia*. The SPP samples CD, EFG, KL, MN, O, ZAA, DDEEFF 1,2,3,4, 5,6,7,8, A1B1C1, D1E1F1, and G1H1I1 had negative impacts on survival of *Menidia beryllina* after 96 hours of exposure. Results of the *Arbacia punctulata* embryo survival and development assay indicate that both endpoints were impacted after their respective exposure periods to all of the Boston Harbor samples.

Bioaccumulation - The *Macoma nasuta*, the bentnose clam, and *Nereis virens*, a burrowing polychaete were exposed to Boston Harbor sediments that had passed the 10-day solid phase test. The tissue samples were analyzed for lipids, metals, chlorinated pesticides, PCBs and PAHs. The results are summarized below.

Eight metals (As, Cd, Cr, Hg, Ni, Pb, and Zn) were analyzed in the tissue of *M. nasuta* and *N. virens* exposed to Boston Harbor sediment. Concentrations of all metals, except chromium in *N. virens*, were above the method detection limits in all replicates analyzed (including background tissues) for both species. Tissue concentrations from two to six metals were significantly greater in *M. nasuta* exposed to Boston Harbor sediment. Concentrations of six metals (As, Cd, Cr, Cu, Hg, and Pb) in tissues exposed to composite MN, the concentration of chromium and lead in sample Y, and the concentration of Cu in composite AB were significantly greater than concentrations in reference tissues. The metal concentrations in *N. virens* exposed to most Boston Harbor composites were not significantly elevated relative to those in organisms exposed to MBDS reference material. However, the concentration of Cu in *N. virens* tissue exposed to composite A1B1C1 were significantly greater than in those worms exposed to the reference sediment.

Twenty-two PCB congeners were analyzed in tissues of *M. nasuta* and *N. virens* exposed to Boston Harbor composites and the MBDS reference sediment. Concentrations of all 22 PCB congeners in *M. nasuta* background tissues were below the method detection limits. Concentrations of four PCB congeners in composites CD, KL, and MN for *M. nasuta* were significantly greater than those organisms exposed to MBDS reference samples. Concentrations of 16 PCB congeners in composites AB, EFG, A1B1C1, and D1E1F1 for *M. nasuta* were significantly greater than those organisms exposed to MBDS reference samples.

Concentrations of nine PCB congeners in *N. virens* background tissues were above the method detection limits. Concentrations of 10 to12 PCB congeners in tissues of *N. virens* exposed to Boston Harbor composites CD, KL, and MN were significantly greater than those in organisms exposed to the MBDS reference. Concentrations of 17 PCB congeners were in tissues of *N. virens* exposed to Boston Harbor composites AB, EFG, A1B1C1, and D1E1F1 were significantly greater than those in organisms exposed to the MBDS reference.

Nineteen pesticides were analyzed in tissues of *M. nasuta* and *N. virens* exposed to Boston Harbor composites AB, EFH, A1B1C1, D1E1F1 and the MBDS reference sediment. Concentrations of 13 analytes were below the method detection limits in all treatments for *M. nasuta* and *N. virens*. In *M. nasuta* tissues, all four test sediments had statistically higher mean concentrations for *g*-chlordane, dieldrin, 4,4'-DDD, and 4,4'-DDE than for those in the reference sediment. Only two pesticides (4,4'-DDE and dieldrin) from the tissue of *M. nasuta* exposed to sample Y had statistically higher mean concentrations than for those in the reference sediment. *N. virens* tissues had statistically higher mean concentrations for a-chlordane, *g*-chlordane, dieldrin, and 4,4'-DDD than the reference mean concentrations for composites AB, EFH, A1B1C1, and D1E1F1.

Twenty-three PAH compounds were analyzed in tissues of *M. nasuta* and *N. virens* exposed to Boston Harbor and MBDS reference sediment. Concentrations of 22 PAH compounds in *M. nasuta* background tissues were above the method detection limits. Concentrations of 19 to 23 PAH compounds in tissues of *M. nasuta* exposed to composites CD, KL, MN were significantly greater than those in tissues of organisms exposed to the MBDS reference sediments.

Concentrations of 22 PAH compounds in *N. virens* background tissues were above the method detection limits. Concentrations of 15 to 20 PAH compounds in tissues of *N. virens* exposed to composites CD, KL, MN were significantly greater than in those organisms exposed to the reference sediment. In composites AB, EFH, A1B1C1, and D1E1F1 eleven of the 23 analytes were statistically higher than the reference sediments.

The Navy Dry Dock composites A1B1C1 and D1E1F1 and the MBDS reference sediment were also analyzed for butyltins. In *M. nasuta* tissues, TTBT and MBT were undetected in all replicates of every treatment. TBT was detected in all replicates of every treatment. In *N. virens* tissues, all analytes were undetected in every treatment except that TBT was detected in tissues from one replicate exposed to the reference sediment and DBT was detected in tissues from two replicates exposed to the composite A1B1C1.

Based on the above results, it expected that all the samples tested from the proposed project area would be determined to be unsuitable for unconfined open water disposal at the MBDS, except the area just south of Castle Island to the North Jetty according to the criteria of the Marine Protection, Research and Sanctuaries Act. Final suitability testing memos will be prepared at a later date. Figure 2-2 gives the expected location for suitable/unsuitable material.

Massachusetts Bay Disposal Site

The average volume of material disposed at the MBDS is 300,000 cy per year. Sediments deposited at MBDS have originated from dredging projects in Boston, Gloucester, and Salem Harbors, as well as various small ports and coastal communities. The MBDS was officially designated as an ocean dredged material disposal site by the U.S. Environmental Protection Agency in 1993. Baseline surveys of the newly designated MBDS were conducted in September 1993 to delineate the topography and sediment composition of the site for the Disposal Area Monitoring System (DAMOS) Program (Murray, 1997). The designated MBDS was relocated approximately one nautical mile (nmi) southwest from the interim MBDS; the interim site was used for the disposal of dredged material from 1977 to 1993.

Results of the 1993 baseline survey indicated that the new MBDS was composed of two relatively distinct areas: 1) the newly incorporated southwestern area, and 2) the northeastern portion which overlaps the interim MBDS. The southwestern area, where no documented disposal of dredged material has occurred, was topographically featureless and sloped gradually towards the northeast. Sediments in this area were composed predominantly of fine-grained silts and clays. The northeastern region contained two major topographic features: the most recent dredged material disposal mound and a large, shallow basin where, historically, dredged material has been disposed. This shallow basin can be enhanced by management for a potential capping site. The highest topographic peak also was observed in this region, outside of the new site boundary, and interpreted as a remnant glacial outcrop.

3.4 Biological Environment

Submerged Aquatic Vegetation (SAV)

Dense meadows of seagrass are characteristic of pristine, shallow depositional environments in New England (MWRA, 2004). A century ago, seagrass meadows covered hundreds of acres of subtidal flats of Boston Harbor. Eelgrass can successfully dominate areas that have sediments ranging from soft mud to coarse sand with average salinities of 10 to 30 ppt (Thayer *et al*., 1984). Light availability is a primary factor limiting both depth and upstream estuary penetration of eelgrass within its temperature and salinity ranges (Thayer *et al*., 1984).

The eelgrass meadows in Boston Harbor had all but vanished by the late 1980's, due to turbid water, viral diseases, and excessive nutrients that promote the growth of algae on seagrass leaves. Boston Harbor now supports only small areas of seagrasses in Hingham Bay in the area near Logan Airport (MWRA, 2004). Until recently, nutrient concentrations in the harbor have been very high, and the water in most areas has not been clear enough for seagrasses. With the reduction in nutrients in the water and the increases in clarity, an effort to recover seagrasses by the U.S. Environmental Protection Agency and MA Division of Marine Fisheries is underway. Eelgrass restoration sites will be located outside the influence of dredging impacts.

Benthic Invertebrates

The continuing studies of the benthos in Boston Harbor that are being conducted by the Massachusetts Water Resources Authority (MWRA) provide a considerable data source for a description of the changes that have occurred within the harbor since discharge modifications began about 15 years ago. As summarized by Maciolek *et al*. (2005), the major changes in discharge regimes that have occurred since the 1995 EIR/S was prepared, were the stoppage of effluent discharge from Nut Island, the complete conversion to secondary treatment in 1998, and the diversion of all treatment discharges from the harbor to the new outfall in September 2000. Maciolek *et al*. (2005) recently compiled a concise summary of conditions in the Harbor since the mid-1970s. Additionally, the samples collected by MWRA provide information about the general faunal communities present and the changes that they have undergone since the EIS was issued in 1995. However, it is important to note that there is one major sampling difference between the MWRA program and the other studies (Pellegrino, 2003; Massport, 2003) discussed in this section. The MWRA infaunal samples are rinsed in the field over a 300-μm-mesh sieve, whereas samples from the other two studies were rinsed over 500-μm-mesh sieves. This difference means that MWRA samples will contain more individuals than the other studies' samples and very likely will also be comprised of more species. Therefore, the data for MWRA stations are not directly comparable to data from the other two studies, although they are presented here to provide background information, especially concerning temporal trends in the communities.

Maciolek *et al*. (2005) also documented the changes that have occurred in the harbor since the cessation of sludge discharge in 1991. The primary changes have involved stations in the northern part of the harbor (comprising the Inner and Lower Harbor regions considered in this SEIS), which were once considered to be heavily polluted. Changes in the northern harbor have included dramatic increases, followed by fluctuations in infaunal abundance and an increase in species numbers and diversity. Stations in the southern part of the harbor, which were less influenced by the former treatment discharges, have not shown changes in the benthos similar to those experienced at the northern stations.

One of the important revelations from the MWRA program is that infaunal abundance can vary tremendously from year-to-year. Annual fluctuations in abundance appeared to be largest from 1992 through about 1998 and seem to have lessened within the last four to five years (Maciolek *et al*., 2005). However, some changes have still been relatively large (*e.g.*, a 13-fold change in abundance at station T05A from 2002 to 2003) and often are related to large fluctuations in abundance of colonizing species such as the amphipod *Ampelisca abdita* and the polychaete worm *Polydora cornuta*. Infaunal abundances have ranged as high as 500,000/m^2 since 1991, but most stations have had abundances much less than half that number within the last five years for which data are available (1999–2003). These data emphasize that an abundance value for a station that is determined for one year only should be considered only relative to other values determined for stations also sampled that year. The one-year abundance value does not necessarily provide a reliable estimate of the infaunal abundance at a particular location for any other year.

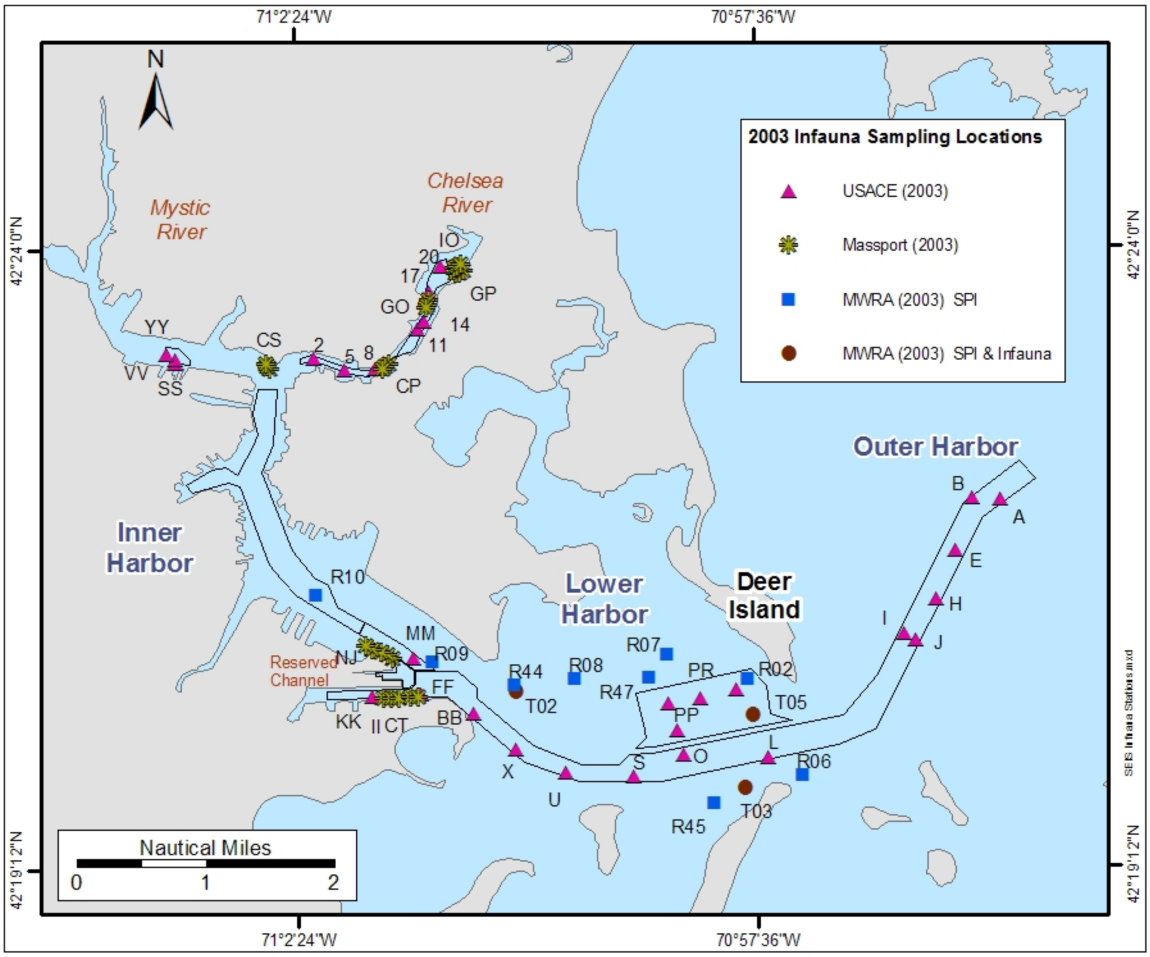
The information presented in this section is derived from two sampling approaches: the collection of sediment profile images (SPI) and the collection of grab samples from which infaunal animals were removed, identified, and counted. SPI data provide information about key habitat characteristics and processes, whereas grab samples allow for the description of infaunal community structure. The two techniques provide different types of information about the benthos and are best used as complementary data sources (Rumohr and Karakassis, 1999). Brief summaries of each approach and descriptions of the types of data described in this section are included in the two text boxes.

Sections of the Mystic River, Chelsea River, and the Reserved Channel and Turning Basin were dredged between May 1998 and September 2000. Portions of the outer harbor region, the lower Main Ship Channel and the Presidents Roads Anchorage area were dredged between August 2004 and June 2005. The implications of this dredging on the benthic characterizations are discussed within the following sections for each harbor area.

Mystic River - The only information available, since 1995, about the benthos in the Mystic River portion of the affected environment is from a Corps survey conducted in September 2003 (Pellegrino, 2003) (Figure 3-3). Three stations were sampled in an area of the Mystic River that is about 35 feet (ft) deep. Sediment data for areas near the stations showed mud or silt present. The three samples showed extremely low infaunal abundances, ranging from 75 to 100 indivduals/m^2; one sample had no animals (Figure 3-4). Only five species were found among the three samples (Figure 3-5), which were dominated by polychaete worms (*Aricidea catherinae*, *Nephtys incisa*, *Tharyx acutus*). Species diversity could only be estimated for one sample, and Shannon's H' was 1.8. Rarefaction analysis was not performed on samples from the Mystic River because the sample sizes were too small to yield meaningful curves.

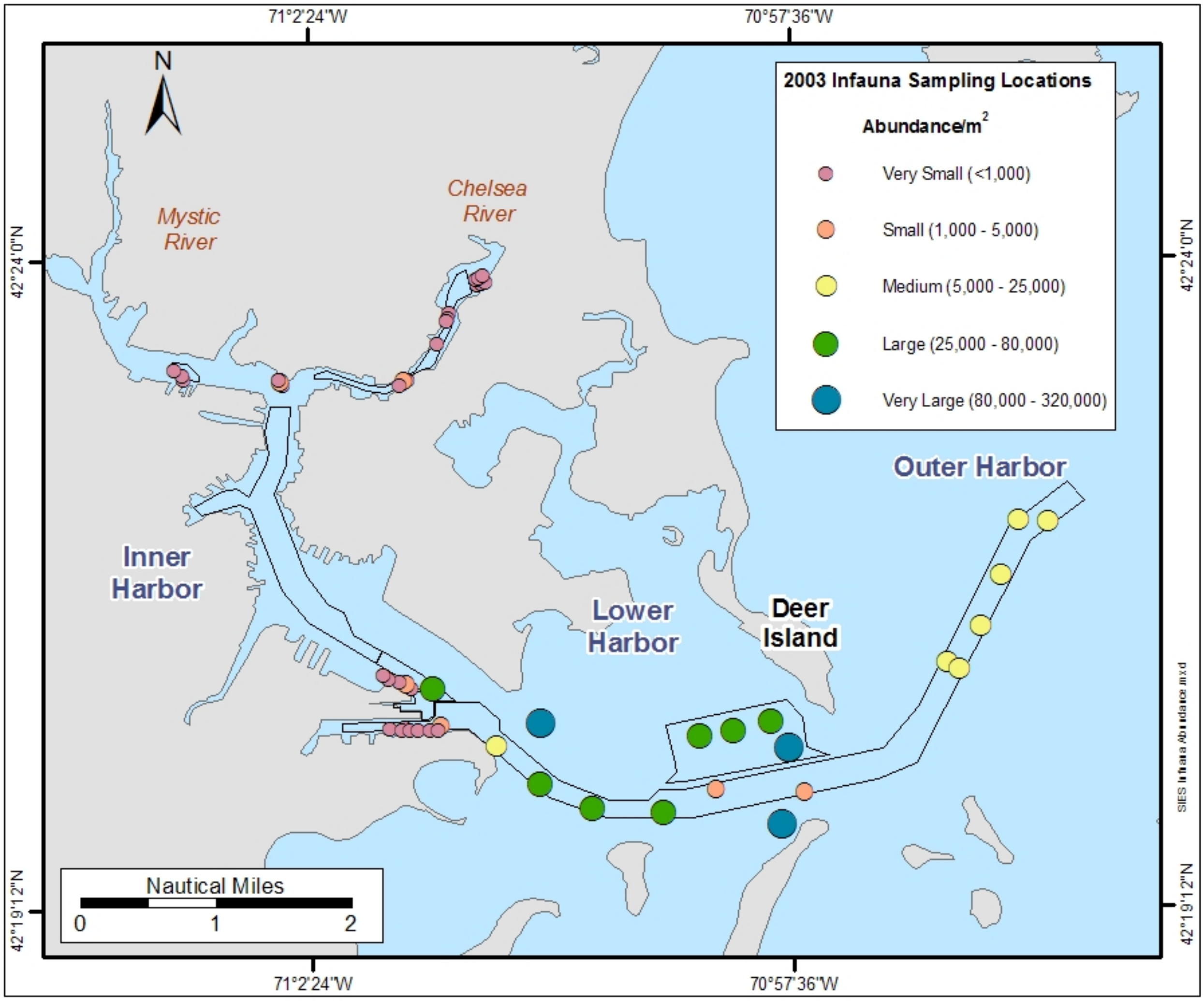
The stations sampled in 2003 were in an area that was not dredged between 1998 and 2000. Therefore, no direct impact of the dredging on the benthos was found in 2003 and the faunal community is certainly representative of that portion of the Mystic River. Indirect dredging impacts, such as increased turbidity, would not be expected to have an impact on the community that would be detectable at least three years after dredging.

Chelsea River - Information about the benthos in the Chelsea River is derived from the Corps (Pellegrino, 2003) and Massport surveys (Massport, 2003). The Upper Chelsea River was sampled at seven stations by the Corps along the length of the river, and at three stations by Massport at each of four berth areas (Irving Oil, Gulf Oil, Conoco Phillips, Global Petroleum) (Figure 3-3). Sediments in the upper Chelsea River were mostly gravel and sand (Figure of bottom type). Water depths generally ranged from about 33 to 38 ft.



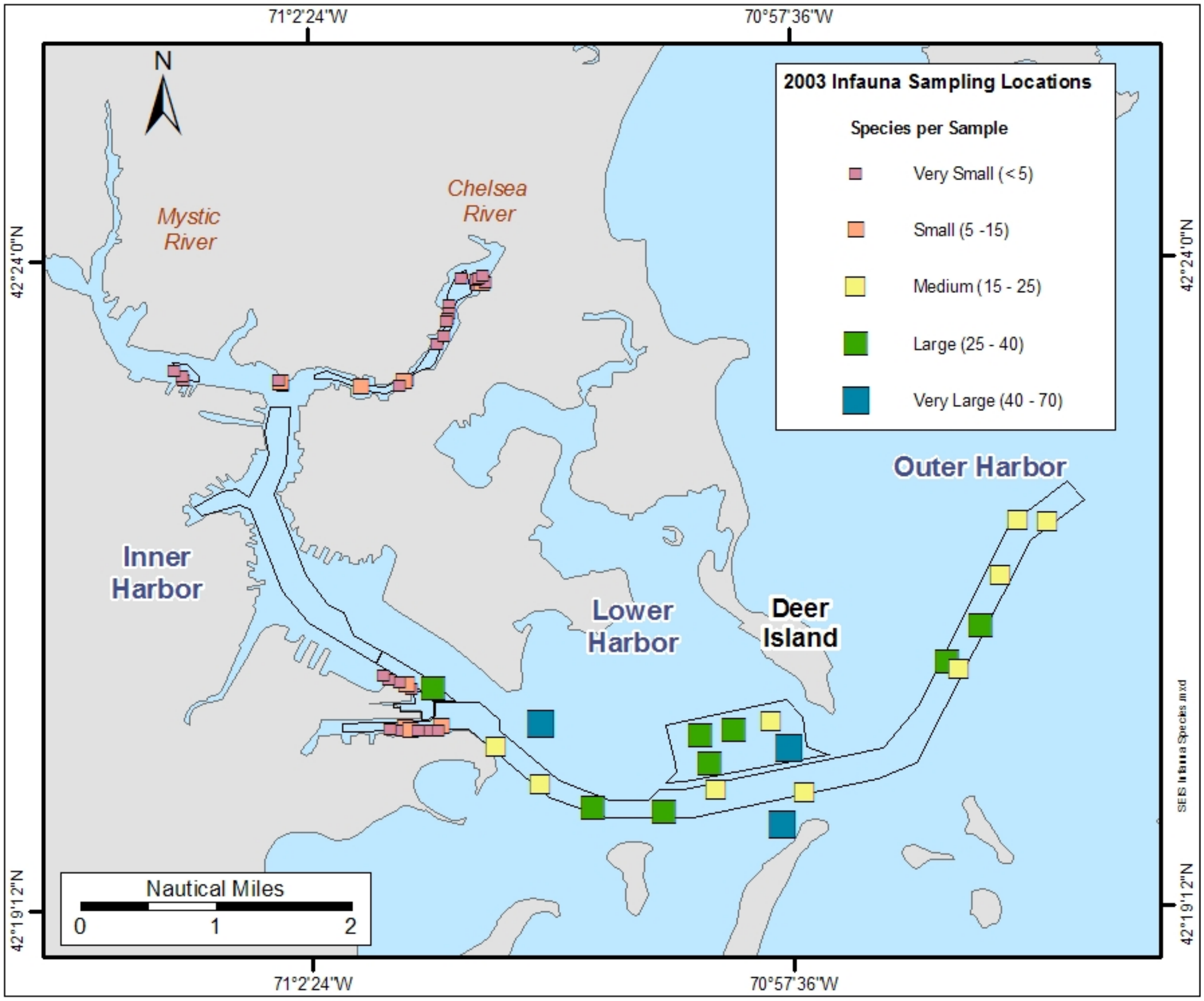
Source: Pellegrino, 2003; Massport, 2003

Figure 3-3. 2003 Infauna Sampling Locations



Source: Pellegrino, 2003; Massport, 2003

Figure 3-4. Infaunal Abundance from 2003 Sampling



Source: Pellegrino, 2003; Massport, 2003

Figure 3-5. Number of Species per Sample from 2003 Sampling

Interpretation of Sediment Profile Imagery

The use of sediment profile imagery is a commonly used technique for evaluating soft-bottom benthic habitats and was pioneered in the early 1970s. The principal purpose is to provide photographic documentation of the relationship between infaunal organisms and their sedimentary habitat. Sediment profile images (SPI) are photographs of a vertical section of the sea floor captured via the deployment of a 35-millimeter camera housed on top of a wedge-shaped prism that penetrates several centimeters into the bottom sediments. The prism has a clear faceplate at the front with a mirror placed at a 45° angle at the back to reflect the image from the faceplate to the camera lens above. The prism has an internal strobe to provide illumination for the image. This wedge assembly is mounted on a moveable carriage within a stainless steel frame. When interpreting SPI, there are several specific features that are particularly useful in evaluating the quality of the habitat.

Sediment Grain Size — grain size is determined by comparing site-specific images with a set of standard images for which mean grain size has been determined in the laboratory. The sediment type descriptors follow the Udden-Wentworth size class system (*e.g.*, clay, sand, gravel, *etc*.). Data are reported as phi units, which indicate approximate particle size and typically range from 4 (fine) to less than −1 (coarse).

Apparent Color Redox Potential Discontinuity (RPD) Layer — an estimation of the depth of the boundary between oxidized and anoxic sediments. It is called the apparent RPD layer because it is a visual estimate based on differences in the reflectivity or color of oxidized and anoxic sediments. It is not an actual measurement of the RPD depth, which must be made with an Eh electrode. The depth of the RPD layer in the sediment increases as the amount of sediment movement by infaunal organisms (bioturbation) increases. Habitats considered to be of good quality have relatively deep (greater than two centimeters) RPD layers.

Infaunal Community Successional Stage — a classification system based on the hypothesis that after a disturbance, infaunal organisms will recolonize a habitat in a predictable sequence leading from the early colonizing stage to the final climax community. The community is classified as Stage I if it primarily consists of dense assemblages of small polychaete worms that move into an area soon after disturbance (colonizers in the sense of Odum [1969]). Stage II is the transitional stage between the colonizing and climax communities and often consists of tube-dwelling amphipods such as *Ampelisca abdita* (Rhoads and Germano, 1986). Stage III represents the mature, climax community consisting of polychaete worms (*e.g.*, maldanid worms) that feed in deeper parts of the sediment and deposit waste material near the sediment surface. The presence of more than one stage in an image is often detected, resulting in classification as Stage I on III or Stage II on III.

Gas Voids — spaces in sediment that occur when organic loading is high. Methane is produced and results in gas-filled voids in the sediment. Voids are recognizable in SPI images because of their irregular shapes and reflection of the strobe light.

Organism-Sediment Index (OSI)—a summary statistic calculated from four SPI parameters: the apparent RPD depth, the community successional stage, the presence/absence of methane gas voids, and the presence/absence of low dissolved oxygen conditions. The index was developed in the 1980s to map disturbance gradients in estuarine habitats (Rhoads and Germano, 1986). OSI values range from −10 to +11, with higher values indicating better habitat quality. An OSI value of 6 is generally used to indicate whether or not a community has recently experienced some type of disturbance, with values less than 6 indicating the influence of disturbance.

Ecological Parameters Used to Characterize Infaunal Communities

The analysis of a benthic sample begins with the identification and counting of the organisms present in the sample. The data resulting from this task are very difficult to understand and interpret by themselves. Therefore, ecologists have developed several univariate parameters that essentially condense the full set of species data into a single number. These parameters range from simple calculations, such as the number of species in a sample, to more complex derivations, such as rarefaction analysis. However, because there is no single metric that can adequately characterize a sample, several metrics should be used in ecological evaluations. The parameters described below are among the more common ones used by marine ecologists to characterize samples, and therefore to characterize communities.

Abundance — a measure of the number of infaunal organisms identified in a defined sample size or area; the actual number of organisms counted is often extrapolated to the number per square meter by dividing the count by the sample area.

Species —the number of species identified in the sample; this value cannot be extrapolated to the number per square meter.

Shannon-Weiner Diversity (H′) — a measure of species diversity that estimates the uncertainty associated with predicting the species of an organism that is randomly selected from a sample. H' is 0 when there is only one species in the sample and is at a maximum when all species in the sample have the same number of individuals. Generally, maximum H' values for marine infaunal communities are between 6.0 and 7.0 for very diverse tropical communities. Maximum values for southern New England communities are generally <5.0.

Sander's Rarefaction —a measure of diversity that can be compared among samples having unequal numbers of individuals. The species estimate is calculated for several randomly-selected subsamples of *n* individuals taken from the original sample. The estimates are displayed graphically as continuous curves by plotting the number of species expected [ES (*n*)] on the Y-axis and the rarified sample size (*i.e.*, number of individuals from the original sample (*n)* described above) on the X-axis. These curves provide a visual comparison of diversity and evenness among samples of different sizes. More diverse samples will have a higher number of species expected for a given sample size than less diverse samples, resulting in "taller" lines. Samples with higher evenness will have steeper curves than those with lower evenness. Because the estimate of species numbers cannot extend beyond the actual sample size, the length of the curves provides an indication of the abundance of the sample. When several graphs are plotted with the same X and Y axes scales, they provide a visual comparison of abundance and diversity among samples and sites.

Evenness (J') — a measure of the distribution of the abundance of organisms in a sample among the species in that sample. The index ranges from 0 to 1 and is at its maximum value when all species in the sample have the same number of individuals.

At the four Corps stations that were located upstream of the Chelsea Street Bridge, infaunal abundance was very low, ranging from 25 to 125 individuals/m^2 (Figure 3-4). Species numbers were also low, with only one to three species found at each station (Figure 3-5). Only polychaete worms (*Nephtys incisa*, *Prionospio steenstrupi*, *Pectinaria gouldii*, *Aricidea catherinae*) were present among the samples. Downstream of the Chelsea Street Bridge infaunal abundances were higher than in samples taken upstream of the bridge but were still very low, ranging from 525 to 1,550 individuals/m^2 (Figure 3-4). Species numbers were also slightly greater than upstream numbers, ranging from 6 to 10 species per station (Figure 3-5). Polychaetes (*Polydora cornuta*, *Tharyx acutus*, *Nephtys incisa*) were the predominant taxonomic group of animals, although the sand shrimp, *Crangon septemspinosa*, and two mollusc species (a snail, *Ilyanassa trivitatta* and a clam, *Nuculana tenuisulcata*) were also present. Species diversity within the Chelsea River was very low to moderate with Shannon's H' ranging from 1.7 to 3.1. Rarefaction analysis was not performed on samples from the Chelsea River because the sample sizes were too small to yield meaningful curves.

The Gulf Oil, Global Petroleum, and Irving Oil berth areas are located upstream of the Chelsea St. Bridge (Massport, 2003). Infaunal abundances among the berth-area samples were similar to those from the other upper river samples, with most ranging from 0 to 200 individuals/m^2 (three of the samples had no animals), although two samples (one Irving Oil, one Global Petroleum) approached 1,300 individuals/m^2 (Figure 3-4). Species numbers were low, ranging from 1 to 12 species per sample (Figure 3-5). Polychaetes (principally *Polydora cornuta* and Cirratulidae spp.) were the predominant organisms among the samples. The Conoco Phillips berth, located just downstream from the Chelsea Street Bridge, showed infaunal abundances (300-2,200 individuals/m^2) that were similar to nearby Corps stations, but were much higher than the upstream berth-area stations (Figure 3-4). Species numbers (4-16 per sample) showed a similar pattern (Figure 3-5). The predominant taxa were primarily the polychaetes *Polydora cornuta* and Cirratulidae spp., but samples also included the mysid crustacean *Neomysis americana*.

Sediments in the Chelsea-Sandwich berth area, which is within the Inner Confluence (where the Mystic and Chelsea Rivers meet), were mostly sandy (Figure 3-1). Water depths generally ranged from about 23 to 36 ft. One of the three samples from the Chelsea-Sandwich Berths area, located where the Chelsea River meets the Mystic River, contained only one snail (*Ilyanassa trivitatta*). The other two samples had infaunal abundances of 2,100 and 5,900 indivduals/m^2 (Massport, 2003) (Figure 3-4). The fauna consisted primarily of polychaetes (Cirratulidae spp., *Lepidonotus squamatus*), oligochaete worms, and nematode worms.

Much of the Chelsea River Channel and the Inner Confluence were dredged between 1998 and 2000. Most of the stations sampled by the Corps (Pellegrino, 2003) and Massport in 2003 were within the recently dredged channel and, thus, represent benthic communities present at least three years after dredging. Because the rates of recovery from disturbance for communities in this type of habitat are not known, it is not possible to estimate whether or not the communities found in 2003 represent a benthos that has fully recovered from the dredging. Stations at the Irving Oil and Global Petroleum berths were not within the dredged channel and likely represent typical conditions for the area. In the vicinity of the Inner Confluence, three benthic stations were sampled during the Massport (2003) survey. One of these (CS-1), which was probably located on the edge of the dredged area, was found to have only one snail in the grab sample. This could reflect a lingering impact from the dredging, but the sample was noted as possibly not from a full grab sample.

Inner Harbor - The data sets available for the characterization of the Inner Harbor area included the Corps 2003 study (Pellegrino, 2003) that sampled the Reserved and Main Channels, the Massport berth area study that sampled Conley Terminal and the North Jetty, and MWRA SPI studies that sampled the Inner and Lower Harbors (Figure 3-3). Sediments in the Reserved Channel area have been characterized as predominantly mud; those in the Main Channel have been characterized as primarily mud with scattered areas of sand (Figure 3-1). Water depths ranged from 39 to 44 ft in the Reserved Channel and from 29 to 43 ft in the Main Channel.

In the Reserved Channel, infaunal abundance ranged from 450 to 1,950 individuals/m^2 at the three Corps stations (Pellegrino, 2003) and from 125 to 2,500 individuals/m^2 at Conley Terminal (Massport, 2003) (Figure 3-4). Taxon numbers were similar for both studies ranging from 4 to 14 species at the Reserved Channel stations (Pellegrino, 2003) and 5 to 22 taxa per sample at Conley Terminal (Massport, 2003) (Figure 3-5). Diversity among the Reserved Channel samples was very low to moderate with Shannon's H' ranging from 1.1 to 3.4. The fauna within the Reserved Channel was characterized by polychaetes (*Nephtys incisa*, *Scoletoma fragilis*, *Polydora cornuta*, Lumbrineridae), the snail *Ilyanassa trivittata*, and the lophophorate worm *Phoronis architecta*. Rarefaction analysis was not performed on samples from the Inner Harbor because the sample sizes were too small to yield meaningful curves.

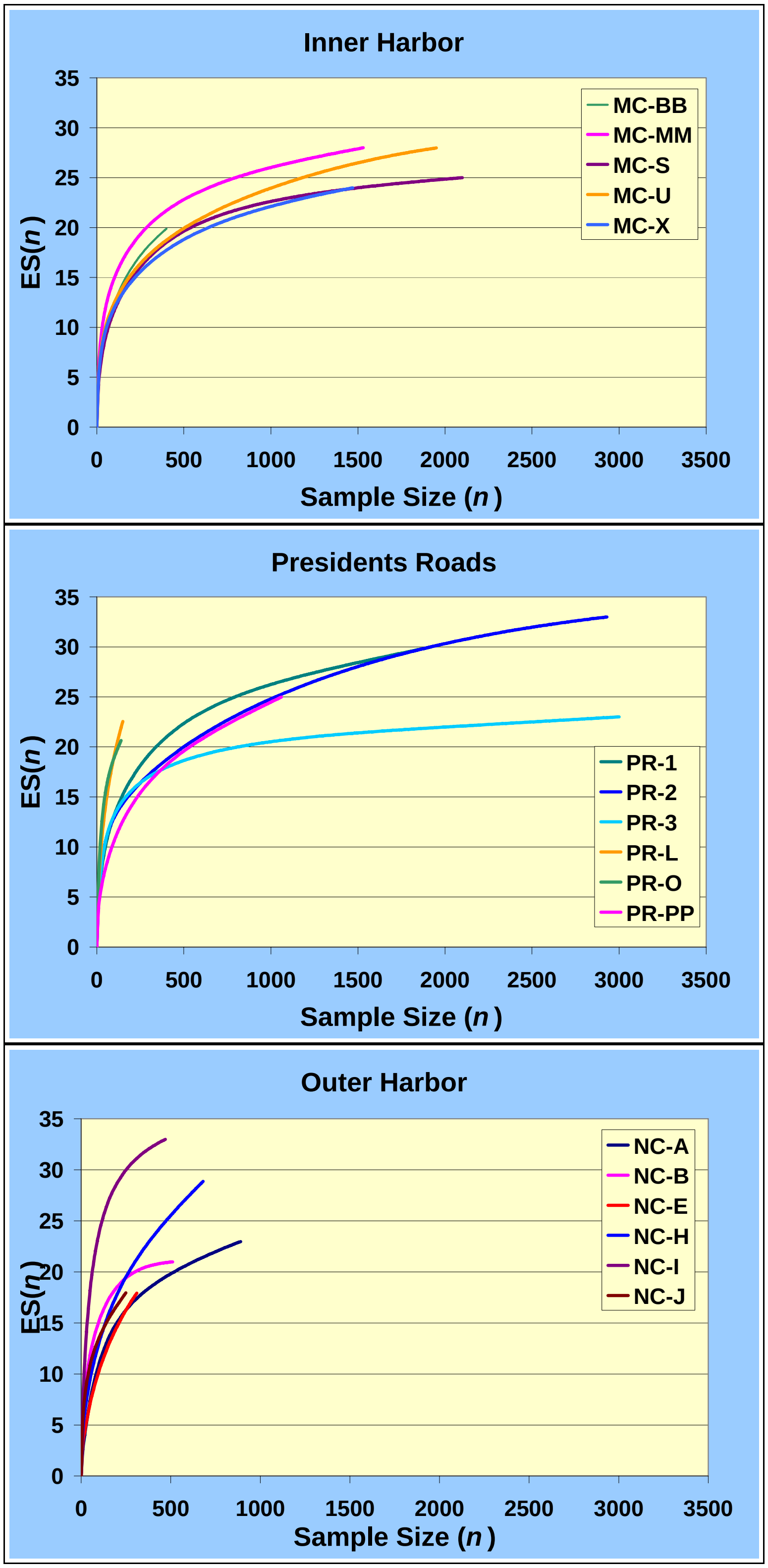
Infaunal abundances at the two Corps stations in the Main Channel were relatively high, about 10,000 and 38,000 individuals/m^2 (Pellegrino, 2003) (Figure 3-4). Species numbers at the two stations were similar with 20 and 28 species per sample (Figure 3-5). Shannon diversity ($H' \approx 3$) was moderate in the channel. The fauna was characterized predominantly by polychaetes (*Aricidea catherinae*, *Tharyx acutus*, *Scoletoma hebes*), although amphipods (*Ampelisca abdita*, *Leptocheirus pinguis*, *Orchomenella minuta*) were also relatively abundant. Rarefaction analysis showed higher diversity than in the Lower and Outer Harbor Main Channel stations, but was considered mid-range when compared with the other harbor stations (Figure 3-6). The North Jetty samples were different from the Corps samples. Infaunal abundance at the North Jetty was an order of magnitude lower, ranging from 1,500 to 3,800 individuals/m^2 (Massport, 2003) (Figure 3-4). Taxon numbers were generally lower, with 10 to 21 taxa present per sample (Figure 3-5). Polychaetes (Lumbrineridae spp., *Marenzellaria viridis*, Capitellidae spp.) were predominant and the snail *Ilyanassa trivittata* was relatively abundant in three of the North Jetty samples. In contrast to the Main Channel stations, crustaceans were rare at the North Jetty stations (Massport, 2003).

Two MWRA stations, R09 and R10, both of which were sampled only by SPI, are located near the Main Channel section of the Inner Harbor (Figure 3-3). Station R09 is close to the Main Channel station MM. Both MWRA stations have shown relatively consistent indications of stress, as indicated by the Organism Sediment Index (OSI) over about the last 10 years of harbor monitoring (Maciolek *et al*., 2005). Station R10, located off the World Trade Center/Commonwealth Pier, has consistently been one of most stressed stations sampled in the harbor with OSI values around 3.7 from 2000 to 2003. Station R09 has shown slightly higher values for the OSI, but they have been at or just less than 6.0 for four of the last five years. Both stations are dominated by physical, not biological processes, and have silty-fine-sand (R09) or silt-clay (R10) sediments. The infaunal successional stage at each station is usually Stage I or Stage I-II, which is also indicative of frequent stress.

All of the stations sampled during the 2003 Corps survey in the Reserved Channel were within the area dredged between 1998 and 2000. The Conley Terminal stations (Massport, 2003) appear to be on the margin of the dredged channel. The descriptions based on the 2003 data from these sites represent benthic communities present at least three years after dredging. Because the rates of recovery from disturbance for communities in this type of habitat are not known, it is not possible to estimate whether or not the communities found in 2003 represent a benthos that has fully recovered from the dredging. The nearby MWRA station (R09) was not within the dredged area.

Lower Harbor - Information about the benthos in the Lower Harbor area is from the Corps 2003 study (Pellegrino, 2003) that sampled the Main Channel and Presidents Roads Anchorage, and the MWRA SPI and infaunal studies that sampled in, and adjacent to, both areas (Figure 3-3). The Main Channel stations are separated into those northwest of Spectacle Island and those in Presidents Roads for this discussion.

The Main Channel area northwest of Spectacle Island (Corps stations 3-3, U, S) showed moderately high infaunal abundance ranging from 37,000 to 53,000 individuals/m^2 (Pellegrino, 2003) (Figure 3-4). Species numbers were moderate, ranging from 24 to 28 species per sample (Figure 3-5). Species diversity was moderately low ($H' = 2.4$ to 2.9). The successional Stage II amphipod, *Ampelisca abdita*, was the predominant species, followed by the polychaetes *Aricidea catherinae*, *Scoletoma hebes*, and *Tharyx acutus*. Oligochaete sp. A was also common. Rarefaction showed lower diversity in this area than at other Main Channel stations (Figure 3-6), but was mid-range compared to other harbor stations. Water depth in the Main Channel was about 40 ft, and the nearby sediments were classified as sand or sandy mud.



ES(n) = Expected number of species for sample size n

Figure 3-6. Rarefaction Curves for Samples Collected from the Boston Harbor Study Area in September 2003 (prepared from data in Pellegrino, 2003).

MWRA stations T02, R44, and R08 provide information about the benthos in the area north of the Main Channel. Stations R08 and R44 have been sampled only by SPI. Station R08 has had an average OSI over the last eight years of 4.5, indicative of stress, and the station still showed moderate stress in 2003, with an OSI value of 6.0 (Maciolek *et al*., 2005). The only infaunal community identified at the station has consisted solely of successional Stage I pioneering fauna, which are also indicative of a stressed habitat. Station R44 showed indications of stress from 1996 to 2000, but since 2000 has shown relatively healthier habitat conditions with an OSI reaching 10.0 in 2003 (Maciolek *et al*., 2005). Sediment at R44 also showed improved conditions with successional Stage II-III fauna present in 2003, and biophysical processes dominating.

Station T02, sampled via SPI and grab sampler, was once thought to be in a highly polluted area with an impoverished fauna (Maciolek *et al*., 2005). Conditions at the station have improved as conditions have changed with the modification of discharges into the harbor. Infaunal abundances increased considerably in 1994 and 1995, decreased in 1996, and remained less than 62,500 individuals/m^2 from 1996 to 2002, before increasing to about 127,000 individuals/m^2 in 2003 (Maciolek *et al*., 2005). There has been a shift in predominant species from pioneering taxa and those sometimes associated with stress (*e.g.*, the polychaetes *Streblospio benedicti* and *Polydora cornuta* and the oligochaete *Tubificoides* nr. *Pseudogaster*) to others such as *Aricidea catherinae*, *Nephtys cornuta*, and *Tubificoides apectinatus* that are often indicative of more stable conditions. Species numbers were about 50 per sample in 2003, the highest number at station T02 since 1994. SPI data generally have shown that the station is stressed with OSI values less than six. However, in 2003 the OSI value (10.0) was the highest calculated in 12 years of monitoring. The fauna at the station consisted of successional Stage II-III taxa (Maciolek *et al*., 2005).

The September 2003 survey showed that stations within the Presidents Roads Anchorage (Corps stations PR-1, PR-2, PR-3, PR-PP) had moderate (~26,000 individuals/m^2) to relatively high (~48,000 to 75,000 individuals/m^2) infaunal abundances (Pellegrino, 2003) (Figure 3-4). Species numbers were also relatively high (Figure 3-5), with 23 to 33 species per sample, and *H'* ~2.2 to 2.8. *Ampelisca abdita* was the predominant organism at stations PR-1, PR-2, and PR-3 with abundances of about 27,000 to 41,000 individuals/m^2; however, the species was absent from station PR-PP. Additional species at stations PR-1, PR-2, and PR-3 included other amphipod species (*Leptocheirus pinguis* and *Orchomenella minuta*), polychaetes (*Tharyx acutus*, *Prionospio steenstrupi*, and two species of *Phyllodoce*), and an oligochaete worm (oligochaete sp. A). At station PR-PP, the predominant taxa included the polychaete worms *Aricidea catherinae*, *Prionospio steenstrupi*, and *Mediomastus ambiseta*. Water depths within the Presidents Roads Anchorage (about 40 ft) were similar at all stations. Sediments were sandy to sandy-mud. Rarefaction analysis showed mid-range diversity and relatively high abundance versus other harbor samples (Figure 3-6).

Two MWRA stations, R02 and T05A, are located within the Presidents Roads Anchorage (Figure 3-3). Station R02, located in the northeast corner of the area, has been sampled by SPI since 1992. Habitat quality here has fluctuated considerably from year-to-year with OSI values in some years showing indications of marked stress (OSI < 6), but in other years showing relatively good conditions with an OSI greater than 8 (Maciolek *et al*., 2005). There have been no identifiable annual trends in OSI values. The most recent (2003) data show good habitat quality at station R02 (OSI = 8.3), with a successional Stage II community. The sediments were affected mainly by biological processes. Station T05A, which is characterized annually by SPI and grab samples, is fully exposed to the mouth of the harbor. SPI data show that the benthic habitat at this station has periodically shown signs of stress with OSI values ranging from 2.3 to 7.0 since 1995 (Maciolek *et al*., 2005). In 2003, SPI data showed a relatively good habitat (OSI = 7.0) at station T05A, with a successional Stage II community, and biological processes affecting the sediment. Infaunal community parameters (measured by grab sample analyses) have shown considerable annual variation. Abundances ranged from as high as about 530,000 individuals/m^2 in 1997 to as low as about 25,000 individuals/m^2 in 2000 (Maciolek *et al*., 2005). Annual fluctuations can be as large as a 40-fold increase in one year (1996–1997), followed by an almost 4-fold decrease the next year (1997–1998). The periodic high abundances are primarily attributed to sudden increases in populations of the polychaete *Polydora cornuta* and the amphipod *Ampelisca abdita*. In 2003, abundances were the second highest recorded at the station, reaching ~317,000/m^2, with amphipods accounting for more than 90% of the total abundance.

All of the stations sampled in the Lower Harbor area by the Corps in 2003, and the MWRA stations (R02, T05A) located within the Presidents Roads Anchorage area, were in the area dredged from October 2004 to June 2005. Therefore, the communities that were described above represent those present more than a year prior to a major disturbance to the harbor bottom and are not typical of the communities likely present there now.

Summary - Infaunal communities within the project study area of Boston Harbor are clearly separable into two geographic regions. The first extends from the innermost region, the Mystic and Chelsea Rivers, to the vicinity of the Reserved Channel. Within this region, infaunal abundances (Figure 3-4) are very low (<1,000/m^2) to low (1,000–5,000/m^2) and species numbers (Figure 3-5) are also very small (<5/sample) or small (5–15/sample). Polychaete, such as *Nephtys incisa*, *Polydora cornuta*, and *Scoletoma fragilis*, predominate among the few infaunal species present. The second region extends from east of Reserved Channel to the mouth of the harbor and includes the Lower Harbor, Main Ship Channel, and Presidents Roads Anchorage area. Infaunal abundances here (based on Corps, 2003b and Massport, 2003 data only; Figure 3-4) range from medium (5,000–25,000/m^2) to large (25,000–80,000/m^2) and species numbers (Figure 3-5) range from medium (15–25/sample) to large (25–40/sample). Predominant taxa in this region often include several polychaete species, such as *Aricidea catherinae*, *Prionospio steenstrupi*, *Scoletoma fragilis*, and *Tharyx acutus*. The tube-dwelling amphipod, *Ampelisca abdita*, is numerically important in the region and other amphipods, such as *Orchomenella pinguis* and *Leptocheirus pinguis*, are also relatively common. This data indicates that the Inner Harbor is more stressed while the Lower Harbor is less stressed with lower organic levels.

Fish

The coastal waters of Massachusetts have extensive finfish resources including numerous demersal, pelagic, migratory, and anadromous species, as well as smaller ecologically important forage species. These waters support substantial commercial and recreational fisheries. Many of the species found in these waters are managed at the Federal level by NOAA Fisheries (*i.e.*, National Marine Fisheries Service or NMFS) through the Magnuson-Stevens Fishery Conservation and Management Act. The Massachusetts Division of Marine Fisheries (MA DMF) also regulates several key fisheries in the nearshore coastal waters. The sections below discuss the finfish species that may occur in the project area. Because no long-term finfish monitoring occurs in the project area, few site-specific finfish data in terms of catch per unit effort (CPUE) are available for review. MA DMF does conduct long-term bi-annual bottom trawl surveys that are designed to describe the groundfish resources over a particular area (*i.e.*, coastal MA) but these were conducted outside the project area (see Figure 3-7). A list of species from this sampling effort is included as some of these species may be present in the project area (see Table 3-6).

Therefore, the discussion below will focus on the life-history characteristics of the managed species and several forage/inshore species of ecological importance that may occur in the project area based on geographic locale and bottom type. A short summary of which species are likely to occur in the specific locations within the project area (Mystic and Chelsea Rivers, Inner, and Lower Harbor) based on species life history characteristics as well as the bottom type in that area is also presented.

Federally Managed Species Including Essential Fish Habitat

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act strengthened the ability of NMFS and the Fishery Management Councils to "protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans." This habitat, referred to as essential fish habitat (EFH), is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Magnuson-Stevens Act requires the Fishery Management Councils to describe and identify EFH for managed species and to draft Management Plans for these species that describe ways to minimize, to the extent practicable, adverse effects on EFH from fishing practices and to identify other actions to encourage the conservation and enhancement of EFH.

The Magnuson-Stevens Act, and the Fish and Wildlife Coordination Act, requires that Federal agencies proposing or undertaking activities that may impact fish populations or their habitat consult with NMFS and Fish and Wildlife Service before permits for the proposed activities may be issued. An EFH consultation has been conducted for this Supplemental EIS/NPC and is included as Appendix A. The consultation includes a detailed description of the fish species and their life-history stages that may be impacted from the proposed action. The consultation also includes a description of how these species may be affected and measures that would be considered to mitigate these impacts.

The NMFS 10 x 10 minute squares of latitude/longitude that encompass the project area were queried to determine which of the Federally managed species and their respective life-history stages have EFH designated within the project area. The 10 x 10 minute squares included in the project area are presented in Figure 3-8. The latitude/longitude coordinates for these squares are:

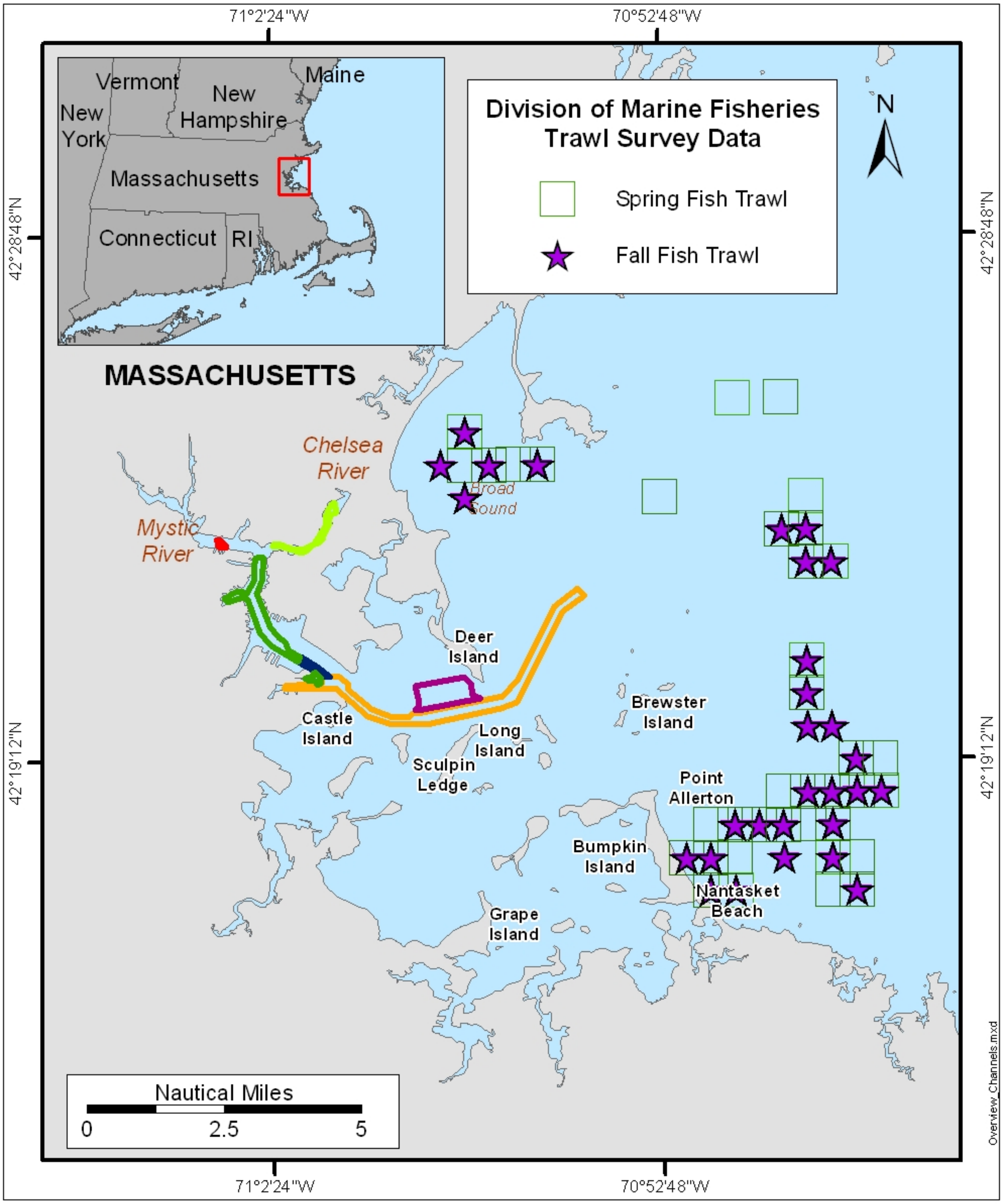


Figure 3-7. MA DMF Spring and Fall Trawl Locations

Table 3-6. Spring and Fall Survey Trawls 1978 – 2005

Table 3-6: Spring Survey Trawls 1978 - 2005

Common Name	Scientific Name	Total Number (1978-2005)
Spiny dogfish	*Squalus acanthias*	1
Winter skate	*Leucoraja ocellata*	144
Clearnose skate	*Raja eglanteria*	3
Little skate	*Leucoraja erinacea*	1145
Thorny skate	*Amblyraja radiata*	41
Atlantic herring	*Clupea harengus*	274
Alewife	*Alosa psuedoharengus*	256
Blueback herring	*Alosa aestivalis*	248
American Shad	*Alosa sapidissima*	49
Rainbow smelt	*Osmerus mordax*	1807
Silver hake	*Merluccius bilinearis*	173
Atlantic cod	*Gadus morhua*	5308
Haddock	*Melanogrammus aeglefinus*	2
Pollock	*Pollachius virens*	377
White hake	*Urophycis tenuis*	60
Red hake	*Urophycis chuss*	207
American plaice	*Hippoglossoides platessoides*	263
Summer flounder	*Paralichthys dentatus*	2
Fourspot flounder	*Paralichthys oblongus*	36
Yellowtail flounder	*Limanda ferruginea*	2502
Winter flounder	*Pseudopleuronectes americanus*	10510
Witch flounder	*Glyptocephalus cynoglossus*	20
Windowpane	*Scophthalmus aquosus*	1199
Atlantic silverside	*Menidia menidia*	2
Threespine stickleback	*Gasterosteus aculeatus*	20
Northern pipefish	*Syngnathus fuscus*	1
Atlantic mackerel	*Scomber scombrus*	6
Butterfish	*Peprilus triacanthus*	1
Striped bass	*Morone saxatilis*	5
Black sea bass	*Centropristis striata*	3
Scup	*Stenotomus chrysops*	1
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	2878
Sea raven	*Hemitripterus americanus*	66
Lumpfish	*Cyclopterus lumpus*	2
Northern searobin	*Prionotus carolinus*	2
Cunner	*Tautogolabrus adspersus*	44
Rock gunnel	*Pholis gunnellus*	1
Snakeblenny	*Lumpenus lumpretaeformis*	2
Daubed shanny	*Lumpenus maculatus*	1
Atlantic wolfish	*Anarhichas lupus*	1
Ocean pout	*Macrozoarces americanus*	2766
Goosefish	*Lophilus americanus*	1
American lobster	*Homarus americanus*	4833
Jonah crab	*Cancer borealis*	170
Atlantic rock crab	*Cancer irroratus*	1890
Spider crab-unclassified	*Majidae*	2
Horseshoe crab	*Limulus polyphemus*	2
Moon snail, Shark eye, and baby	*Naticidae*	265
Blue mussel	*Mytilus edulis*	93
Northern moonsnail	*Euspira heros*	3
Sea scallop	*Placopecten magellanicus*	11
Ocean quahog	*Arctica islandica*	6
Razor and Jackknife clams	*Solenidae*	1
Longfin squid	*Loligo Pealeii*	4

Fall Survey Trawls 1978 – 2005

Common Name	Scientific Name	Total Number (1978-2005)
Spiny dogfish	*Squalus acanthias*	511
Winter skate	*Leucoraja ocellata*	132
Little skate	*Leucoraja erinacea*	1621
Atlantic herring	*Clupea harengus*	204
Alewife	*Alosa psuedoharengus*	12
Blueback herring	*Alosa aestivalis*	96
American Shad	*Alosa sapidissima*	2
Rainbow smelt	*Osmerus mordax*	12864
Silver hake	*Merluccius bilinearis*	577
Atlantic cod	*Gadus morhua*	5043
Haddock	*Melanogrammus aeglefinus*	19
Pollock	*Pollachius virens*	75
White hake	*Urophycis tenuis*	635
Red hake	*Urophycis chuss*	259
Spotted hake	*Urophycis regia*	1
American plaice	*Hippoglossoides platessoides*	120
Summer flounder	*Paralichthys dentatus*	2
Fourspot flounder	*Paralichthys oblongus*	48
Yellowtail flounder	*Limanda ferruginea*	807
Winter flounder	*Pseudopleuronectes americanus*	6475
Windowpane	*Scophthalmus aquosus*	548
Atlantic silverside	*Menidia menidia*	378
Northern pipefish	*Syngnathus fuscus*	2
Atlantic mackerel	*Scomber scombrus*	11
Butterfish	*Peprilus triacanthus*	19720
Atlantic moonfish	*Selene setapinnis*	31
Scup	*Stenotomus chrysops*	103
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	361
Sea raven	*Hemitripterus americanus*	17
Lumpfish	*Cyclopterus lumpus*	17
Atlantic seasnail	*Liparis atlanticus*	4
Cunner	*Tautogolabrus adspersus*	129
Rock gunnel	*Pholis gunnellus*	16
Ocean pout	*Macrozoarces americanus*	170
Goosefish	*Lophilus americanus*	2
Atlantic saury	*Scomberesox saurus*	1
Mackerel scad	*Decapterus macarellus*	984
Bigeye scad	*Selar crumenophthalmus*	3
Rough scad	*Trachurus lathami*	21
American lobster	*Homarus americanus*	18322
Jonah crab	*Cancer borealis*	511
Atlantic rock crab	*Cancer irroratus*	3729
Spider crab-unclassified	*Majidae*	1
Lady crab	*Ovalipes ocellatus*	88
Moon snail, Shark eye, and baby	*Naticidae*	226
northern horsemussel	*Modiolus modiolus*	1
Blue mussel	*Mytilus edulis*	18
Sea scallop	*Placopecten magellanicus*	25
Atlantic surfclam	*Spisula solidissima*	1
Ocean quahog	*Arctica islandica*	14
Northern shortfin squid	*Illex illecebrosus*	4
Longfin squid	*Loligo pealeii*	33152
Longfin squid egg mops	*Loligo pealeii egg mops*	

Table 3-7. Coordinates for EFH Squares in the Project Area

	North	East	South	West
Square 1	42° 30.0' N	71° 00.0' W	42° 20.0' N	71° 10.0' W
Square 2	42° 20.0' N	71° 00.0' W	42° 10.0' N	71° 10.0' W
Square 3	42° 30.0' N	70° 50.0' W	42° 20.0' N	71° 00.0' W
Square 4	42° 20.0' N	70° 50.0' W	42° 10.0' N	71° 00.0' W

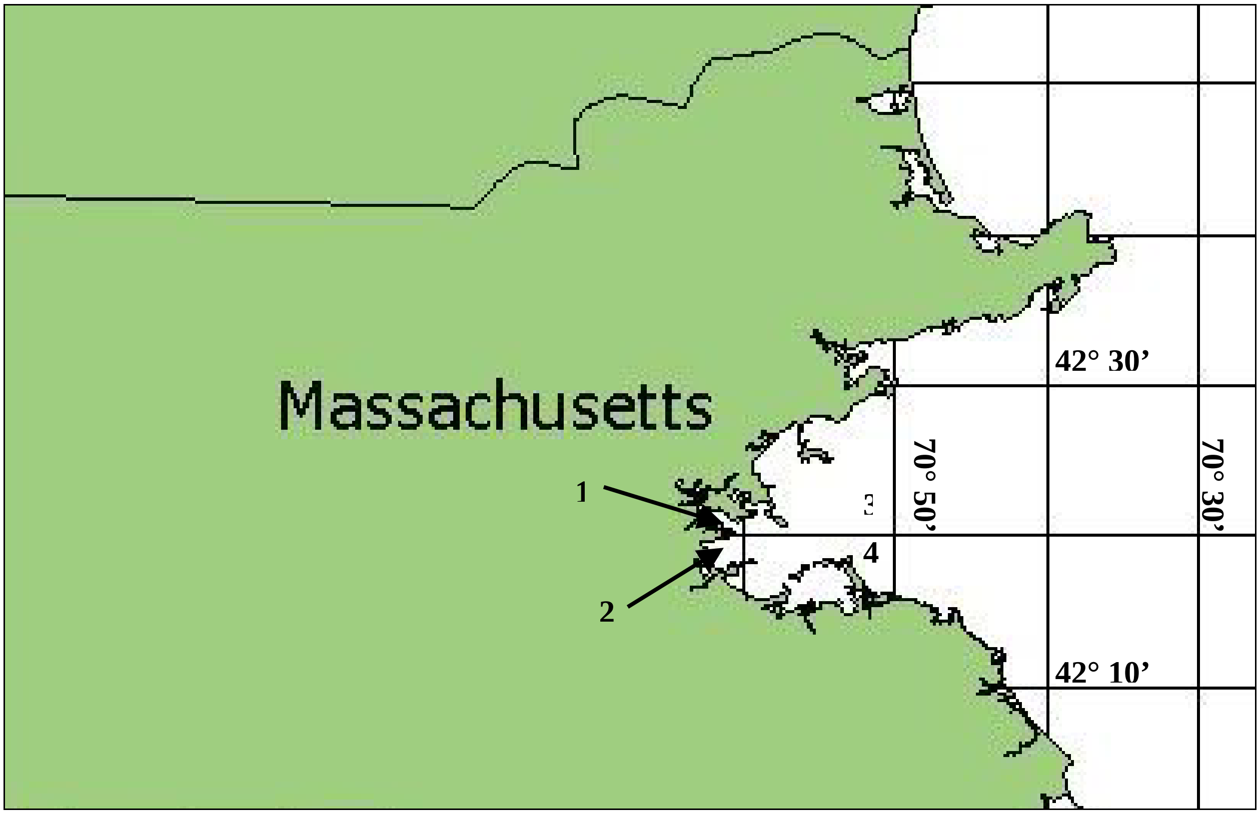


Figure 3-8. 10 x 10 Minute Squares Encompassing the Project Area

The species that may be present in the project area based on the bottom habitat present are listed below in Table 3-8. Fourteen of these species are managed by the New England Fishery Management Council. Nine are managed by the Mid-Atlantic Fishery Management Council, and one, the bluefin tuna, is managed as a highly migratory species. Two shellfish species (Atlantic sea scallop [*Placopecten magellanicus*] and surf clam [*Spisula solidissima*] [see Section 3.4 for discussion of shellfish resources]), two invertebrates (long-finned squid [*Loligo pealei*] and short-finned squid [*Illex illecebrosus*]), and 20 finfish species have EFH designated within the project area. Finfish species include demersal and pelagic species, several of which are migratory to the northeast region and within the project area.

Table 3-8. EFH Species Within the Project Area

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Atlantic cod* *Gadus morhua*	S	S	M,S	M,S	S
Haddock* *Melanogrammus aeglefinus*	S	S			
Pollock* *Pollachius virens*	S	S	M,S		
Whiting (silver hake)* *Merluccius bilinearis*	S	S	M,S	M,S	
Red hake* *Urophycis chuss*		S	S	S	
White hake* *Urophycis tenuis*	S	S	S	S	
Winter flounder* *Pseudopleuronectes*	M,S	M,S	M,S	M,S	M,S
Yellowtail flounder* *Pleuronectes ferruginea*	S	S	S	S	S
Windowpane flounder* *Scophthalmus aquosus*	M,S	M,S	M,S	M,S	M,S
American plaice* *Hippoglossoides platessoides*	S	S	S	S	S
Ocean pout* *Macrozoacres americanus*			S	S	
Atlantic halibut* *Hippoglossus hippoglossus*	S	S	S	S	S
Atlantic sea scallop* *Placopecten magellanicus*	S	S	S	S	S
Atlantic sea herring* *Clupea harengus*		S	M,S	M,S	
Bluefish** *Pomatomus saltatrix*			M,S	M,S	
Long-finned squid** *Loligo pealei*	n/a	n/a		X	X
Short-finned squid** *Illex illecebrosus*	n/a	n/a		X	X
Atlantic butterfish** *Peprilus triacanthus*	S	S			
Atlantic mackerel** *Scomber scombrus*	M,S	M,S	M,S	M,S	
Summer flounder** *Paralichthys dentatus*				X	
Scup** *Stenotomus chrysops*			X	X	
Black sea bass** *Centropristus striata*			X	X	
Surf clam** *Spisula solidissima*	n/a	n/a	X	X	
Bluefin tuna *Thunnus thynnus*			X	X	

Source: NOAA Fisheries Service, Habitat Conservation Division, http://www.nero.noaa.gov/hcd/ma1.html
M = Mixing water/brackish salinity zone (0.5 ppt < salinity < 25 ppt); S = Seawater salinity zone (salinity $\geq$ 25 ppt)
n/a = species does not have this lifestage in its life history
X = EFH has been designated within a 10 x 10 minute square for the species and lifestage; however, no additional information as to salinity zone is reported
*Managed species by the New England Fishery Management Council
**Managed species by the Mid-Atlantic Fishery Management Council

Demersal species are those that live on or near the bottom and feed on benthic organisms or other bottom dwelling fish. Flat-bodied groundfish species such as winter flounder, summer flounder, yellowtail flounder, windowpane flounder, and the American plaice, as well as the more full-bodied species such cod, haddock, halibut, pollock, hakes, ocean pout, sea bass, and scup are considered demersal. Pelagic species are those that occupy open waters between the coast and edge of the continental shelf, often in depths of 66 to 1,312 ft. Pelagic species tend to be more mobile than demersal species, and many are highly migratory. Some species also form large schools. Examples of pelagic species include herrings, butterfish, squid, mackerels, and bluefish. Species such as the Atlantic mackerel, bluefin tuna, and bluefish are also highly migratory. More detailed information pertaining to the life-history characteristics, such as geographic distribution, bottom type preferences, migrations, spawning and food preferences, are described in Table 3-9 for these Federally managed species.

The Estuarine Living Marine Resource Database (ERLM; Jury *et al*., 1994) categorizes the species present in Boston Harbor in terms of highly abundant, abundant, common, or rare. Highly abundant species are numerically dominant relative to other species with similar life modes; abundant species are those that are often encountered in substantial numbers relative to other species with similar life modes; common species are defined as those that are frequently encountered, but not in large numbers; and rare species are those that are definitely present but not frequently encountered.

Table 3-9. Life History Information of Managed Species and Non-managed Species Likely to be Found in the Project Area

Species	Distribution	General Habitat	Bottom Type	Migrations	Spawning	Eggs and Larvae	Food
Federally Managed Species							
Demersal Species							
American plaice (*Hippoglossoides platessoides)*	Labrador and to Montauk Pt. New York	Bays and continental shelf waters from 148 to 574 ft in depth	Bottom habitats with fine-grained sediments or sand and gravel	Move inshore in spring for spawning	March through mid June	Pelagic eggs and larvae	Small crustaceans, polychaetes, sand dollars sea urchins and primarily brittle stars
Atlantic cod (*Gadus morhua*)	Greenland to North Carolina	Continental shelf waters from 33 to 492 ft in depth	Rocky slopes or ledges, rock, gravel, mud, sand, clay	Extensive migrations with seasons, and in response to food	November through May	Pelagic eggs and larvae	Extensive diet but mainly mollusks, crabs, lobsters, shrimp, brittle stars
Atlantic halibut *(Hippoglossus hippoglossus)*	Greenland and Labrador to Virginia	Bays and continental shelf waters from 328 to 2297 ft in depth	Bottom habitats with a substrate of soft mud, sand, gravel or clay; rough or rocky bottoms along slopes of outer banks	Juveniles have extensive migrations	Late fall through early spring peaking in Nov. – Dec.	Bathypelagic eggs (170-656 ft) and pelagic larvae	Changes with increasing size including a variety of crustaceans, mollusks and fish
Black sea bass (*Centropristis striata*)	Maine to Florida	Estuaries, Bays and continental shelf waters from 66 to 164 ft in depth	Structured hard bottom (shellfish beds, pilings, wrecks, offshore ledges, reefs)	Move inshore during spring and summer	May through July	Pelagic eggs and larvae	Crabs, lobsters, shrimp, mollusks
Haddock (*Melanogrammus aeglefinus*)	Greenland to North Carolina	Continental shelf waters from 40 to 492 ft in depth	Sand, rock, pebbles, broken shell	May move in response to food	January through June	Pelagic eggs and larvae	Extensive diet of crustaceans, mollusks, worms, shrimp
Ocean pout (*Macrozoarces americanus*)	Labrador to Delaware	Continental shelf waters 105 to 112 ft in depth	Sand-mud, sticky sand, gravel, rocks	Changes habitats when seasons change: winter- spring in sand-gravel areas; summer-fall in rocky area	September and October	Demersal eggs and larvae	Shelled mollusks, crustaceans, echinoderms
Pollock *(Pollachius virens)*	Scotian Shelf, Georges Bank, Great South Channel and Gulf of Maine	Continental shelf waters from 49 to 1198 ft in depth	Hard, stony or rocky bottoms, including artificial reefs	As juveniles, inshore-offshore movements linked to temperatures eventually staying offshore as adults	September through April peaking in Dec – Feb.	Pelagic eggs and larvae	Euphausiid crustaceans, fish and mollusks
Red hake (*Urophycis chuss*)	Gulf of St. Lawrence to Virginia	Continental shelf waters from 33 to 427 ft in depth	Soft mud and silt (juveniles near shellfish beds)	Extensive seasonal migrations – inshore in spring and summer and offshore in winter	May through November	Pelagic eggs and larvae	Shrimp, crustaceans, squid, small fish
Scup (*Stenotomus chrysops*)	Massachusetts to North Carolina	Continental shelf waters from shoal areas (7 ft) to deeper waters (607 ft)	Rocky bottoms	Move inshore in spring-summer and offshore in winter	Summer	Pelagic eggs and larvae	Crustaceans, worms, hydroids, sand dollars, young squid
Summer flounder (*Paralichthys dentatus*)	Gulf of Maine to South Carolina	Estuaries, Bays and continental shelf waters to 82 ft in depth	Mud or sand	Move offshore in fall	Fall and early winter	Pelagic eggs and larvae	Small fish, shrimp, crustaceans squid, mollusks, worms, sand dollars
Whiting (*Merluccius bilinearis*)	Newfoundland to South Carolina	Continental shelf waters from 98 to 1066 ft in depth	All substrate types	Move inshore in spring and offshore in fall – vertical migrations in response to prey	Late spring and early summer	Pelagic eggs and larvae	Herring, other small schooling fish
White hake *Urophycis tenuis*	Gulf of St. Lawrence to Mid-Atlantic Bight	Estuaries, Bays and continental shelf and slope waters from 16 to 1066 ft in depth	All substrate types	May retreat to the deeper waters during winter	Early spring off Southern Georges Bank	Pelagic eggs and larvae	Polychaetes, shrimps, crustaceans and fish
Windowpane flounder (*Scophthalmus aquosus*)	Gulf of St. Lawrence to Florida	Large estuaries in waters up to 246 ft in depth	Sand, mixtures of sandy silt or mud	Not likely to undergo inshore – offshore migrations	Late spring and summer	Pelagic eggs and larvae	Squid, crabs, small mollusks, worms
Winter flounder (*Pseudopleuronectes americanus*)	Labrador to Georgia	Estuaries, Bays and continental shelf waters from tide mark to 328 ft in depth	Muddy sand with patches of eelgrass, sand, clay, gravel or cobble	Generally localized small scale migrations inshore in winter	February – June	Demersal eggs, pelagic larvae	Mollusks, crustaceans, worms, sea cucumbers
Yellowtail flounder (*Pleuronectes ferruginea*)	Labrador to Chesapeake Bay	Continental shelf waters from 66 to 164 ft in depth	Sand or sand and mud mixtures	Not likely to undergo inshore – offshore migrations	Spring and summer – may spawn at depths up to 410 feet	Pelagic eggs and larvae	Small bivalves, crustaceans, shrimp, worms

Table 3-9 (continued). Life History Information of Managed Species and Non-managed Species Likely to be Found in the Project

Species	Distribution	General Habitat	Bottom Type	Migrations	Spawning	Eggs and Larvae	Food
Pelagic Species							
Atlantic butterfish (*Peprilus triacanthus*)	Newfoundland to Florida	Estuaries and Bays to continental shelf waters generally less than 394 ft in depth	Surface waters over sand bottoms	Move offshore and south during winter	June through August	Pelagic eggs and larvae	Small fish, squid, amphipods, shrimp
Atlantic mackerel *(Scomber scombrus*)	Gulf of St. Lawrence to North Carolina	Continental shelf waters from surface to 1247 ft in depth	Not dependent on coastline or bottom	Highly migratory – appear near coast in spring – disappear in fall	Spring and early summer	Pelagic eggs and larvae	Copepods, pelagic crustaceans, small fish
Atlantic sea herring (*Clupea harengus*)	Labrador to North Carolina	Continental shelf waters from 66 to 427 ft in depth; in large schools	Only during spawning – in gravel, cobble, sand substrates	May migrate to inshore areas during spawning	July through November	Demersal eggs, demersal, then pelagic larvae	Plankton (larval snails, diatoms, crustaceans)
Bluefish (*Pomatomus saltatrix*)	Highly migratory: Maine to Florida	Continental waters (~80 nautical miles (nmi) offshore) in schools	Juveniles may occur along beaches, estuaries, tidal creeks over sand and gravel	Migrate north in spring and south in fall	June through October	Pelagic eggs and larvae	Fish, crustaceans
Bluefin tuna *(Thunnus thynnus*	Highly migratory, worldwide in temperate and tropical waters	Continental shelf and slope waters	All substrate types	Known to migrate across the Atlantic	Appear in New England waters in June, unknown when spawning occurs	Pelagic eggs and larvae	Fish
Long-finned squid (*Loligo pealei*)	Gulf of Maine through Cape Hatteras, NC	Continental shelf waters to 1000 ft	All substrate types; eggs found in sandy-mud bottoms; attached to rocks, pilings or algae	Move inshore during spring and summer and offshore in mid-late fall and winter	Spawn in May, hatch in July	Eggs are demersal and enclosed in gelatinous capsules of up to 200 eggs	Small planktonic prey, crustaceans, small fish
Short-finned squid *Illex illecebrosus*	Gulf of Main through Cape Hatteras, NC	Continental shelf waters to 597 ft	All substrate types	Move offshore in late fall	Spawn December through March	Gelatinous egg balloons containing 10,000 – 100,000 eggs	Small planktonic prey, crustaceans, small fish
Non-Federally Managed Species							
Anadromous Species							
Alewife (*Alosa pseudoharengus*)	Newfoundland and Gulf of St. Lawrence to SC	Streams, Rivers, Estuaries and Bays and out to 60 nmi offshore	Spends most of life at sea as a pelagic schooling species; will run up rivers/streams to spawn in still water	Run up rivers in May through June to spawn and may be seen moving out of rivers after spawning as late as August	May through August	Eggs and larvae develop in freshwater where spawning occurred, after a month, begin movement downstream. Eggs stick to brush or stones	Generally a Plankton feeder: copepods, amphipods, shrimps, appendicularians
American shad (*Alosa sapidissima*)	Newfoundland and Gulf of St. Lawrence to FL	Streams, Rivers, Estuaries and Bays and offshore to depth of 156 to 408 ft	Spends most of life at sea as a pelagic schooling species; will run up rivers/streams to spawn in areas with sandy or pebbly shallows	Enter rivers in spring and early summer to spawn and may be seen moving out of rivers as late as August	May through August	Eggs and larvae develop in freshwater where spawning occurred, after a month, begin movement downstream. Eggs are semi buoyant	Generally a Plankton feeder: copepods, euphausiid shrimps, fish eggs and occasionally bottom dwelling amphipods
Blueback herring (*Alosa aestivalis*)	Southern New England to Northern FL	Streams, Rivers, Estuaries and Bays and near bottom in shelf waters	Spends most of life at sea as a pelagic schooling species; will run up rivers/streams to spawn in still water	Similar to the alewife, runs up rivers to spawn, only runs later in the season that the alewife (when water temps are warmer)	May through August	Eggs and larvae develop in freshwater where spawning occurred, after a month, begin movement downstream. Eggs stick to brush or stones	Generally a Plankton feeder: copepods, pelagic shrimps, launce and small fish fry
Rainbow smelt (*Osmerus mordax*)	Labrador to northern NJ, Alaska and Arctic Canada	Harbors, Estuaries, Bays, River mouths and Inshore areas not more than 0.9 nmi out	Spends most of life in harbors or brackish estuaries as a pelagic schooling species; will run upriver to spawn; generally not as far upstream as others	Runs up rivers to spawn, may also move slightly offshore from the Bays and Harbors if water gets too warm during summer months	March through May	Eggs and larvae develop in freshwater where eggs stick to rocks, brush *etc.* larvae begin moving into more saline waters at about 1¼ inch.	Small crustaceans, sea worms, small fish

Table 3-9 (continued). Life History Information of Managed Species and Non-managed Species Likely to be Found in the Project

Species	Distribution	General Habitat	Bottom Type	Migrations	Spawning	Eggs and Larvae	Food
American eel (*Anguilla rostrata*) Catadromous species	Eastern North America to northern South America including the Bahamas	Streams. Rivers, Estuaries and Bays and coastal waters	Muddy bottom and still water	Reside in freshwater regions and migrate to sea water during winter and early spring to spawn	Spawns midwinter far out at sea	Thought to have pelagic eggs; have pelagic leptocephalus larvae	Scavengers; will eat anything living or dead including a variety of small fish and crustaceans
Forage/Shore Species							
Atlantic menhaden (*Brevoortia tyrannus*)	Nova Scotia to Florida; Gulf of Mexico, and South to Argentina	Bays, estuaries and continental shelf waters	Pelagic schooling species, all substrate types	Migrate north in spring and south in fall	Spawns June through August	Pelagic eggs and larvae	Microscopic plants and small crustaceans
Atlantic tomcod (*Microgadus tomcod*)	Gulf of St. Lawrence to Virginia	Estuaries, Bays, Harbors, mouths of rivers	Strictly an inshore fish, demersal, muddy bottoms, salt marshes	Do not carry out inshore-offshore migrations regularly, but some more south populations may move into deeper (cooler) waters during summer	Spawn November through February in estuaries and moths of streams/rivers	Demersal eggs masses which stick to seaweeds or stones; unknown larval stages	Small crustaceans, worms, small mollusks, squid, fish fry
Cunner (*Tautogolabrus adspersus*)	Newfoundland and the Gulf of St. Lawrence to Chesapeake Bay	Coastal waters just below the tidemark; generally in waters 15 – 20 ft deep. Will run into deep salt creeks	Demersal species on bottom substrates of eelgrass, pilings of wharves, under floats in harbors, rock pools	Are year-round residents but may move into slightly deeper water during winter or to escape really high temperatures during summer	Spawn late spring through early summer	Pelagic eggs and larvae	Omnivorous and will feed on eelgrass, amphipods, shrimp, lobsters, crabs, bivalves, mollusks, worms, sea urchins and fish such as silversides, sticklebacks, pipefish, mummichogs and fish fry
Tautog (*Tautoga onitis*)	Nova Scotia to SC	Coastal waters not more than 3 nmi from land or 30 to 60 ft in depth	Demersal species around steep rocky shores, breakwaters, ledges, wrecks, piers and cocks and rock piles/boulders and mussel beds	No apparent migrations with seasons. Like cunner, may move into slightly deeper water during extreme cold or warm periods	Spawn primarily in June	Pelagic eggs and larvae	Primarily bivalve and univalve mollusks, crabs, hermit crabs, sand dollars, shrimps, lobsters
Striped bass (*Morone saxatilis*)	Gulf of St. Lawrence to north FL, northern Gulf of Mexico, pacific coast	Inshore coastal waters, seldom more than a few nautical miles from shore; may move into estuaries, river mouths and rivers	Powerful swimmers, often swim at surface, congregate in small groups, may sink to the bottom during the daylight ; sandy, rocky substrates	Move north in the spring and south in the fall. May run into estuaries or freshwater rivers to spawn	Spawn primarily in June	Eggs are semi-buoyant and are spawned in turbulent waters to prevent eggs from settling; pelagic larvae	Other fish and a wide variety of invertebrates (lobsters, crabs, shrimps, squid, mussels)
White perch (*Morone americana*)	Gulf of St. Lawrence and Nova Scotia to SC	Estuaries, Bays, River mouths, land-locked freshwater ponds. Generally shallow water	Not a bottom fish (except in winter), are a schooling species	May run up into freshwater or brackish water for spawning. Tend to be year-long residents but will move to deeper locations in Bays/creeks during winter	Spawn April through June	Eggs will stick together in masses and sink or stick to objects they encounter. Larvae are pelagic	Small fish fry, spawn of other fish, young squid, shrimps, crabs.
Mummichog (*Fundulus heteroclitus*)	Gulf of St. Lawrence to Texas	Salt marshes, tidal creeks, shores of harbors, moths of streams and estuaries	Sheltered shores where tide flows over eelgrass or *Spartina*, will bury in mud	No migration, a stationary fish – will overwinter in mud	Spawn June through early August in a few inches of water	Eggs are sticky and will mass in clumps and stick to sand grains, or other objects	Omnivorous – plant and animal (diatoms, eelgrass, shrimps, small crustaceans), dead or alive
Silversides (*Menidia spp*)	Southern Gulf of St. Lawrence to Chesapeake Bay	Confined to coastline in inner bays, brackish water and mouths of rivers	Sandy shores, gravelly shores, among the *Spartina* in salt marshes	Resident throughout the year but may sink deeper in winter	May through early July on sandy bottom or among Spartina	Eggs sink and stick in ropy clusters or sheets	Omnivorous – algae, diatoms, copepods, mysids, shrimps, small decapods, fish eggs, young squid, annelid worms and mollusk larvae
Northern searobin (*Prionotus carolinus*)	Bay of Fundy to SC	Coastal waters from the tide line to depths of 30 to 180 ft	Around rocks, smooth hard grounds, less often on mud	Seasonal inshore – offshore migrations (appear inshore in may-June and move to deeper waters of the shelf in October	June through September with peaks in July and August	Pelagic eggs and larvae	Shrimps, crabs, amphipods, crustaceans, squid, bivalve mollusks and small fish
Longhorn sculpin (*Myoxocephalus octodecemspinosus*)	Newfoundland and Gulf of St. Lawrence to VA	Estuaries, Bays, Harbors and coastal waters where it may come to flats at high tides and to depths of 300 ft	Demersal on shoals and flats, wharves	No seasonal migrations but will stay in the deeper channels in coldest part of winter and during heat of summer	Spawning November through January	Eggs sink and stick together in clumps and will adhere to anything (empty clamshells, finger sponges *etc.*); planktonic larvae	Shrimps, crabs, amphipods, hydroids, worms, mussels, other mollusks and fish fry; are scavengers

Table 3-9 (continued). Life History Information of Managed Species and Non-managed Species Likely to be Found in the Project Area

Species	Distribution	General Habitat	Bottom Type	Migrations	Spawning	Eggs and Larvae	Food
Shorthorn sculpin (*Myoxocephalus scorpius*)	Northern Labrador to Southern New England	Bays and ledges rising from smooth bottom in shoal waters	Demersal fish on substrates of mud, sand, pebbles, bare bottom or among weeds, wharves,	No seasonal migrations but will stay in the deeper channels in coldest part of winter and during heat of summer	Spawning November through February	Eggs sink and stick together in spongy masses on sandy bottoms, pools in rocks, seaweeds, or any crevice or hollow; planktonic larvae	Crabs, shrimps, sea urchins, worms, fish fry; are scavengers and will eat debris
Grubby (*Myoxocephalus aenaeus*)	Gulf of St. Lawrence and Nova Scotia to NJ	Estuaries, Bays, and coastal waters from tide mark to 90 ft in depth	Demersal on many substrates including eelgrass	Local resident, no apparent migrations	Spawning continues throughout the winter	Eggs sink and adhere to any object it encounters; planktonic larvae	Annelid worms, shrimps, crabs, copepods, snails, nudibranch mollusks, ascidians and small fish
Threespine stickleback (*Gasterosteus aculeatus*)	Labrador and Newfoundland to Chesapeake Bay	Strictly a shore fish; freshwater and saltwater; may drift out to sea	A small fish (< 4 inches); ditches and creeks of tidal marshes; brackish ponds and lagoons; weedy shores in shallow water; hiding under clumps of floating eelgrass and rockweed if away from shore	No apparent migrations	Spawning in estuaries; likely to be May and June	Male builds nest of grass/weeds and eggs stick to nest; male guards eggs and young fry until fry drift away.	Small invertebrates, small fish fry and fish eggs
Fourspine stickleback (*Apeltes quadracus*)	Gulf of St. Lawrence and Nova Scotia to Virginia	Strictly a shore fish; freshwater and saltwater	A small fish (< 2 ½ inches); ditches and creeks of tidal marshes, brackish ponds/lagoons, weedy shores in shallow water	No apparent migrations	Spawning in May through July	Male builds a nest and places eggs in the nest and guards	Assumed to be similar to the diet of the Threespine stickleback
Ninespine stickleback (*Pungitius pungitius*)	Arctic seas south to New York	Strictly a shore fish; freshwater and saltwater	A small fish (< 3 inches); Creeks in tidal marshes; shore lines in harbors	No apparent migrations	Likely during summer months	Male may build a nest in grass or weeds. May be similar to the Threespine stickleback	Spawn and young of other fish
Northern pipefish (*Syngnathus fuscus*)	Southern Gulf of St. Lawrence to SC	Salt marshes, harbors and river mouths; may drift out to sea	A small fish (4-8 inches); found among eelgrass or seaweeds; hiding under clumps of rockweed if found at sea	No apparent migrations	March to August	Males nurse eggs in a brood pouch; males maintain young in brood pouch until 8-9 mm	Minute crustacean, fish eggs and small fry
Rock gunnel (*Pholis gunnellus*)	Hudson Strait to Delaware Bay; numerous north of Cape Cod	Shoal waters; along low tide mark; also on offshore banks to depths of 240 ft	Under stones, among seaweed, prefers, pebbly, gravelly, stony ground or shell beds	No apparent migrations	Assumed to be November through February or March	Eggs are laid in holes or crannies, adhesive eggs,; planktonic larvae	Assumed to be carnivorous – small mollusks and crustaceans
American sand lance (*Ammodytes americanus*)	Labrador, Newfoundland and Gulf of St. Lawrence to Cape Hatteras, NC	Sandy foreshores; shoaled parts of offshore banks, congregate in dense schools	Sandy substrates where they burrow in the sand	Moves offshore into deeper water during the winter	Unknown, but egg production appears to be in late fall/early winter	Eggs appear to be deposited on sandy bottoms where they stick to sand grains; pelagic larvae	Small crustaceans and fish fry
Skates (*Raja spp*)	Eastern coast of the US spp vary, but may extend from Nova Scotia south to FL	Bottom dwelling in Bays, estuaries and continental shelf waters at various depths	Smooth, rocky, soft bottoms or sand and gravel	Variable, some species may move inshore and offshore seasonally	Variable, eggs may be laid during winter months and hatch in spring, laid in the summer and into autumn	Lay large eggs which become fastened to seaweeds or other objects	Omnivorous, shrimps, crabs, lobsters, mollusks worms and fish
Spiny dogfish (*Squalus acanthias*)	Labrador to Florida	Coastal waters and shelf edge waters	All substrate types	Seasonal migrations moving north in spring and summer and south in fall and winter. Also make inshore-offshore migrations in response to temperature	Female dogfish bear young live (1-15 pups). This occurs offshore in winter	Fertilization in internal, embryonic development is internal and young are born live	Fish, crustaceans

Source: Bigelow and Schroeder, 1953; Cross *et al*., 1999; U.S. Fish and Wildlife Service, 1978, various EFH source documents: http://www.nefsc.noaa.gov/nefsc/habitat/efh/

In the project area, Jury *et al*. (1994) suggest that highly abundant federally managed species include winter flounder. Abundant species include Atlantic herring, American plaice, and yellowtail flounder. Common species include Atlantic cod, whiting (silver hake), pollock, red hake, white hake, bluefish, ocean pout, Atlantic mackerel and windowpane flounder. Rare species include spiny dogfish, haddock, scup, butterfish, and smooth flounder.

In a July 21, 2005 letter from the U.S. Department of Commerce, NOAA Fisheries, Northeast Region to Mr. Michael Keegan at the U.S. Army Corps of Engineers, NOAA Fisheries suggested that among the species listed with EFH in the project area, particular attention should be focused on the winter flounder (*Pseudopleuronectes americanus*). Winter flounder is one of the most common commercially exploited species found in Massachusetts Bay. North of Cape Cod, this species spawns in estuaries or nearshore areas from February through May (Klein-MacPhee, 1978), generally over sandy bottoms in water from 6 to 20 ft in depth (Bigelow and Schroeder, 1953). Winter flounder eggs are demersal and adhesive (Pearcy, 1962) and may be found on tidally submerged gravel bars and attached to fronds of macroalgae (Crawford and Carey, 1985). In Boston Harbor, eggs are abundant between February and May (Jury *et al*., 1994). Winter flounder larvae stay near the bottom (Pearcy, 1962) and are highly abundant in Boston Harbor in March through May (Jury *et al*., 1994). As winter flounder larvae mature and metamorphose into juveniles, they move to the lower portions of the estuary. Winter flounder larvae are negatively buoyant and appear to maintain their positions in estuaries by rising and sinking in the water column to take advantage of incoming and outgoing tides (Crawford and Carey, 1985; Pearcy, 1962). In the fall, young-of-the-year (YOY) winter flounder will move out of estuaries and shallow-water areas to deeper water.
Juvenile winter flounder less than four years of age are common in shallow waters during the summer along the New England coast.

Juvenile and adult winter flounder are highly abundant in Boston Harbor year-round (Jury *et al*., 1994). During summer months when temperatures are high, juveniles and adults move to deeper channels and areas where water temperatures are cooler (McCracken, 1963; Howe and Coates, 1975). In late fall and winter, when temperatures drop, juveniles and adults move into deeper waters or move out of the estuary (Pearcy, 1962). In the spring, winter flounder return to their natal estuary to spawn (Saila, 1961; Howe and Coates, 1975).

In support of long-term monitoring for the Massachusetts Water Resource Association (MWRA) outfall, winter flounder were collected annually from 1991 to the present to obtain tissue for chemical analysis. To collect the appropriate numbers of winter flounder, otter trawls were conducted at five general locations, and winter flounder CPUE was calculated. Trawls were conducted during the late spring or early summer months of any given year at locations near Deer Island, Nantasket Beach, Broad Sound, the Outfall location, and East Cape Cod Bay.

Figure 3-9 presents the results of 14 years of winter flounder catch data in support of the MWRA program. Winter flounder catch appears to fluctuate regularly at several of the locations, with the most consistent catches from the Deer Island region. Deer Island also shows some of the lowest catches for most years. Peaks in the catch are seen in 2002 at four of the five locations including Deer Island, Nantasket Beach, Broad Sound, and East Cape Cod Bay. At the outfall location CPUE fluctuated regularly until 1999. A large increase in catch was observed in 2000, and appears to be increasing through the 2004 sampling period. The presence of winter flounder at all sites suggests that adequate habitat exists at these locations to support winter flounder. The differences observed may be due to fish moving to different locations throughout the harbor and surrounding areas to feed or escape temperature extremes.

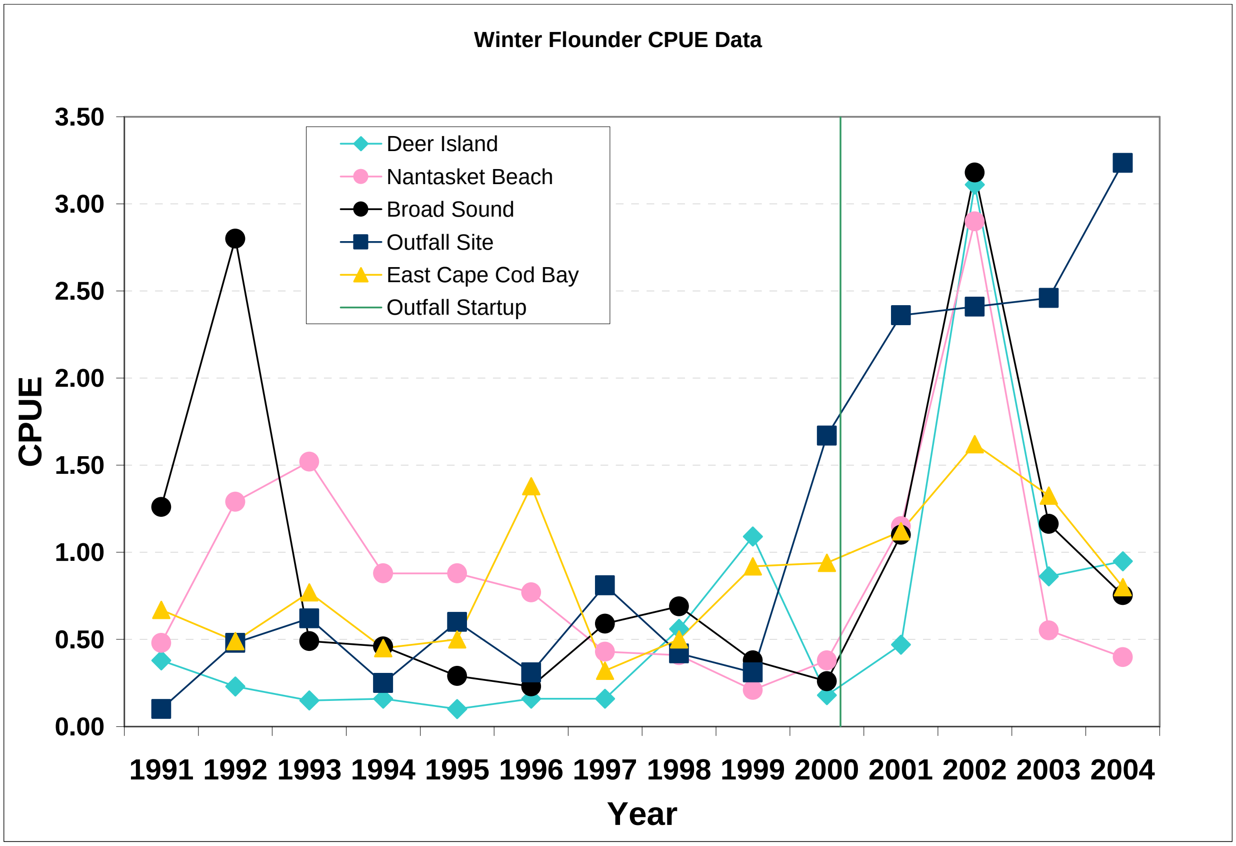


Figure 3-9. Winter Flounder CPUE Data from Locations within Boston Harbor

State-Regulated Species

In addition to the Federally managed species, MA DMF regulates various finfish species that are restricted by quotas. MA DMF also regulates fisheries by gear types other than hook and line. MA DMF compiles data by gear type for sea bass, conch, and scup from fish pots, and for a variety of finfish collected by fish weirs and gill nets. Quotas on landings are set as a means of conserving various species and may be adjusted for any given year based on projected landings. Quota-managed species include black sea bass, bluefish, dogfish, summer flounder, long-finned squid, short-finned squid, scup, and striped bass.

Of the fish managed by MA DMF, one of the most heavily fished species in and around the project area is the striped bass (Vin Malkoski, personal communication, Aug. 2005). The striped bass, or "striper," is one of the most avidly pursued of all U.S coastal sport fish. It is native to most of the eastern Atlantic coast, ranging from the lower St. Lawrence River in Canada to Northern Florida, and along portions of the Gulf of Mexico. Striped bass have been introduced into the west coast and, because of its adaptability to freshwater, its range has expanded to include inland areas as well. Striped bass are stocked into lakes and reservoirs in at least 31 states.

Striped bass can live up to 40 years and reach weights greater than 100 pounds, although individuals larger than 50 pounds in Massachusetts state waters are rare (MA DMF, 2005b). Sexual maturity is attained at two or three years of age for males and after age four for females. The size of females at sexual maturity has been used as a criterion for establishing minimum legal size limit regulations.

In general, the striped bass is a migratory species and is seen in Massachusetts's waters from the spring through autumn. Although juveniles less than two years of age do not appear to migrate, adults will move north to the New England coastal areas during the spring and return to more southern locales in the autumn. Striped bass are most abundant in the New England states following years when reproduction in the Chesapeake Bay has been particularly successful. While in Massachusetts's coastal waters, striped bass are rarely found more than several nautical miles from the shoreline. These fish are generally located in river mouths, in small, shallow bays and estuaries, and along rocky shorelines and sandy beaches. They are particularly active within tidal and current flows and in the wash of breaking waves. Most feeding occurs from dusk to dawn. Their diet is extensive and includes alewives, flounder, sea herring, menhaden, mummichogs, sand lance, silver hake, tomcod, smelt, silversides, and eels, as well as lobsters, crabs, soft clams, small mussels, annelids (sea worms), and squid.

Non-Regulated Species

In addition to the Federally managed species and State-regulated species, the Estuarine Living Marine Resource Database (ERLM; Jury *et al*., 1994) identifies additional non-regulated species present in the project area and categorizes them in terms of highly abundant, abundant, common or rare. Highly abundant species include mummichog and silversides. Abundant species include skates, American eel, alewife, rainbow smelt, Atlantic tomcod, and cunner. Common species include blueback herring, Atlantic menhaden, fourspine stickleback, threespine stickleback, ninespine stickleback, northern pipefish, grubby, longhorn sculpin, striped bass, tautog, rock gunnel, and American sand lance. Rare species include American shad, northern searobin, shortfin sculpin and white perch. Life history characteristics of these species, including general distribution, habitat and food preferences, as well as spawning and migratory information, are presented in Table 3-9.

In a July 21, 2005 letter from the U.S. Department of Commerce, NOAA Fisheries Northeast Region to Mr. Michael Keegan at the Corps, three anadromous species included in the ELMR database (Jury *et al*., 1994) have been identified through the Fish and Wildlife Coordination Act as species requiring particular attention. Although not regulated by Federal or State agencies, the coastal waters, bays, and estuaries off Massachusetts also support a variety of anadromous fish species. Anadromous species are those that spend most of their juvenile and adult lives in coastal or estuarine regions, but will migrate into freshwater rivers to spawn. The rainbow smelt (*Osmerus mordax*), alewife (*Alosa pseudoharengus*), and blueback herring (*Alosa aestivalis*) use Boston Harbor, the Mystic River, and Chelsea River for passage to upstream spawning locations.

The rainbow smelt is an inshore species that spends most of the year in harbors and estuaries (Bigelow and Schroeder, 1953). The smelt is not a large fish, generally not exceeding 13-14 inches in length, and is very slender, weighing from 1 to 6 ounces. Adults are common in Boston Harbor except during the summer months (Jury *et al*., 1994). During the warmest periods of the summer, smelt leave the harbor to find slightly cooler water (Collette and Klein-MacPhee, 2002). Spawning occurs in freshwater in early spring. Rainbow smelt migrate into the Mystic and Chelsea Rivers; however this species generally does not move too far upstream and may only venture a few hundred yards above the tidewater (Bigelow and Schroeder, 1953). There is a dam on the Mystic River and currently, the fish do not move above this dam; however, there are plans to have a fish passage constructed for this area. Adult smelts return to the harbors and estuaries immediately after spawning. Eggs remain in freshwater areas adhering in clumps to pebbles, sticks, grass, or weeds; hatching occurs in about 13 days (Bigelow and Schroeder, 1953). Young fry appear to move out of the river spawning areas in early summer. Juveniles are abundant or common in Boston Harbor year-round (Jury *et al*., 1994).

The alewife is common in Boston Harbor from April through October, with adults becoming abundant during May and June (Jury *et al*., 1994). The alewife is not a particularly large fish, never attaining lengths much more than 15 inches and weights of 8 – 9 ounces (Bigelow and Schroeder, 1953). The alewife spends most of its life in large schools in coastal waters. Spawning occurs in the spring when adults move up into freshwater rivers where they were hatched, such as the Chelsea and Mystic Rivers, to spawn (Bigelow and Schroeder, 1953). Spawning takes place in sluggish waters, with females depositing from 60,000 to 100,000 eggs, dependant on body size. Following spawning, the alewife immediately returns from freshwater to the coastal areas. Eggs remain in freshwater attached to brush, stones, or anything they settle upon, and hatch in approximately six days. When fry are about one month old, they begin making their way downstream to more saline environments (Bigelow and Schroeder, 1953).

The blueback herring is closely related to the alewife and is very similar in size and habitats. It is a schooling species that spends most of its life in seawater, but swims into freshwater regions to spawn. Together with the alewife, these two species comprise the commercially important river herring fishery in the Gulf of Maine. The blueback herring is common in Boston Harbor from May through October (Jury *et al*., 1994). Blueback herring migrate into the freshwater Mystic and Chelsea rivers to spawn; however, unlike the alewife, the blueback migrate into these rivers a little later in the season and does not go as far upstream as the alewife (Bigelow and Schroeder, 1953). Eggs sink and will stick to anything they encounter. Hatching occurs in approximately 50 hours. Within one month, young show characteristics of the adult and begin moving downstream into saltwater regions (Bigelow and Schroeder, 1953).

In addition to the anadromous species listed above, and the Federally-managed and State-regulated species that support many fisheries, the project area is home to many species of small, local fish populations such as mummichog, silverside, various species of stickleback, sculpin, grubby, gunnel, and the sand lance. Although these fish serve no commercial or recreational fishery, they are ecologically important. Many are small and confined to inshore areas only. They can be found in saltwater canals and creeks, particularly in marsh areas bordering harbors and estuaries. Many of these species serve as food sources for coastal and shore birds, foraging mammals, and the commercial and recreationally important fish species. More detailed life history information for these species is presented in Table 3-9.

Fish Species in the Project Area

Mystic River - The bottom type within the Mystic River is predominately fine sediments (mud, silt and clay) (Figure 3-1). All of the anadromous species listed in Table 3-9 (alewife, American shad, blueback herring, and the rainbow smelt) may be found moving into the Mystic to spawn during the spring and early summer months. The Atlantic tomcod, a demersal inshore species, may also be present around the mouth of the river feeding and spawning (fall and early winter). White perch are generally a schooling species that is often found in the mouths of rivers along the MA coastline. This species may also run up into more freshwater portions of the river during spring for spawning. Striped bass may also be found in the mouths of rivers, particularly in areas where there is tidal and current flow. Several small forage species including mummichogs, silversides, sticklebacks and pipefish are also year-round residents in inshore areas both in freshwater and saltwater. These species are often found along weedy shorelines or hiding under clumps of floating eelgrass or rockweed if away from the immediate shoreline.

Chelsea River - The bottom type within the Chelsea River is a heterogeneous mix of gravel and sand, with areas of finer sediments (silt, mud, clay) (Figure 3-1). The same fish species that are likely to be present in the Mystic River are also likely to use various regions of the Chelsea River for feeding and/or spawning.

Inner Harbor - Mud and clay are the predominant sediment types within the Inner Harbor (Figure of 3-1) and any number of the fish species presented in Table 3-9 above may be present in the harbor at various times or may be permanent residents. Many of the anadromous species that move into the Mystic and Chelsea Rivers will migrate through the Inner Harbor en route to spawning locations in the rivers. Some species like the rainbow smelt may spend most of its life in the harbor area. Striped bass may also be found moving through the inner harbor to locations near the mouths of the Mystic and Chelsea Rivers. Local, inshore species present in the Inner Harbor may include Atlantic tomcod, cunner, tautog, white perch, mummichogs, silversides, northern pipefish, longhorn and shorthorn sculpins, and threespine, fourspine and ninespine sticklebacks. Several federally managed demersal species may also be found in the Inner Harbor based on their preference for muddy bottom types and life history characteristics. These include: black sea bass, summer flounder, winter flounder, windowpane flounder, and white hake. These species will move to inshore locations during spring and summer, but if temperatures get too warm may stay in the deeper channels in those inshore areas.

Lower Harbor - The Lower Harbor consists primarily of muddy and sandy substrate. This type of bottom habitat is suitable to a number of (Figure 3-1) the fish species presented in Table 3-9. Similar to the Inner Harbor, many of the anadromous species migrate through the lower portions of the harbor en route to spawning locations in the Mystic and Chelsea Rivers. Rainbow smelt are likely to be found in pelagic schools for a large portion of their life in the Lower Harbor region migrating to the river regions to spawn. Striped bass may also migrate through the area to reach more rocky shorelines or sandy areas of the small islands located in the lower harbor region. Several of the small inshore forage fish species including mummichogs, silversides, sculpins, grubby, shorthorn and longhorn sculpin, and ninespine stickleback may be present along the shorelines of many of the small islands in the Lower Harbor region. Various species of skates as well as spiny dogfish are also likely to be present, moving between more inshore and offshore locations depending on water temperature.

Of the managed species, many demersal fish preferring either muddy and more fine grained substrates or sandy substrates will be found foraging in the Lower Harbor and may make seasonal migrations between the Lower and Inner and/or the Lower and Outer Harbor in response to water temperatures. The demersal species likely to be present include American plaice, Atlantic halibut, summer flounder, winter flounder, windowpane flounder, red and white hake, and yellowtail flounder. Scup and black sea bass may also be present in the Lower Harbor around any rocky outcroppings or structured hard bottom such as shellfish beds pilings, or ledges. Pelagic species such as Atlantic butterfish and Atlantic mackerel may make seasonal migrations to the Lower Harbor areas for spawning and foraging.

Shellfish

Several commercially and recreationally important species of shellfish, such as softshell clam (*Mya arenaria*), blue mussels (*Mytilus edulis*), razor clams (*Ensis directus*), and rock crab (*Cancer irroratus*) and Jonah crab (*C. borealis*) occur within the affected environment and are discussed in this section. Lobsters are discussed in the section below this section. Infaunal invertebrates that occur in the project area were discussed in the above section. Shellfish that are designated as having essential fish habitat (EFH) within the project area (Atlantic sea scallop [*Placopecten magellanicus*], Atlantic surf clam [*Spisula solidissima*], and ocean quahog [*Arctica islandica*]) are discussed in more detail in the Essential Fish Habitat (EFH) Evaluation (Appendix A).

Recent data (*i.e.*, since 1995) describing the distribution of shellfish in Boston Harbor are very limited. The NOAA Fisheries Agency (NMFS) identified softshell clam, blue mussels, and Atlantic surf clams (in nearby Broad Sound) as shellfish resources of concern within or near the project area (NMFS, 2005).

The Massachusetts Department of Marine Fisheries (MA DMF), in collaboration with the Massachusetts Office of Coastal Zone Management (CZM) and the NOAA Coastal Services Center (CSC), developed a map of shellfish suitability areas that shows the approximate location of potential habitats suitable for ten species of shellfish along the coast of Massachusetts (Figure 3-10). These areas were determined to be suitable for shellfish based on the expertise of the MA DMF, the opinion of local Massachusetts Shellfish Constables, and information contained in maps and studies of shellfish in Massachusetts. These areas include sites where shellfish have historically been collected but may not currently support any shellfish.

Site-specific shellfish studies were not conducted for this project. Recent samplings conducted within the harbor (Pellegrino, 2003; Massport, 2003) (Figure 3-3 in the Benthic Infauna section) in September 2003 were designed to collect benthic infauna community data, although some data regarding the presence of shellfish were generated. Absence of a species from samples collected does not necessarily mean that the species does not occur in the project area.

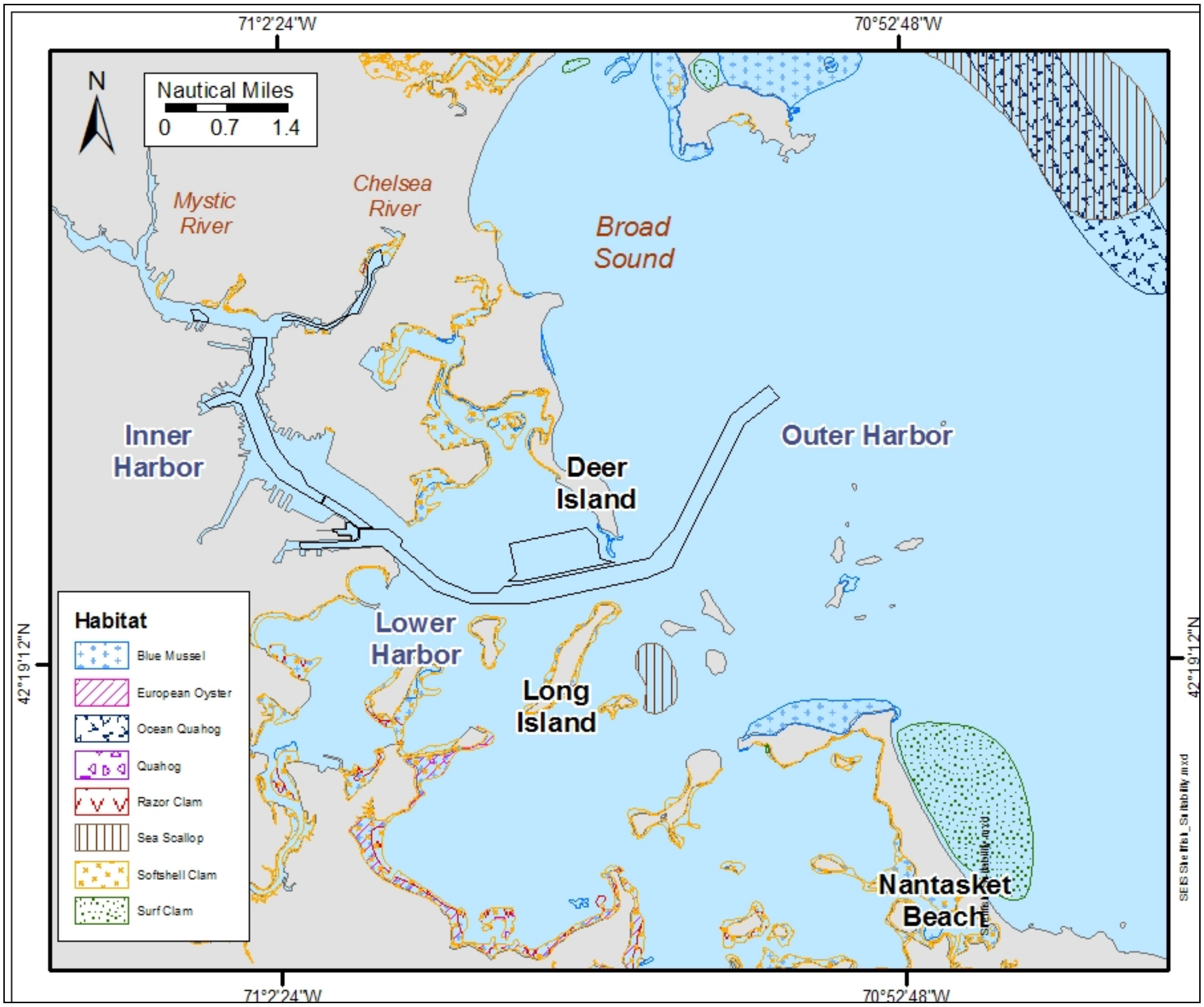


Figure 3-10. Shellfish Suitability Areas (MA DMF, 2004)

Mystic River - Habitat for softshell clams has been identified by MA DMF along the northern bank of the Mystic River (Figure 3-9), but not within the channel. The bottom type within these areas is mostly mud (Figure 3-1), which is consistent with the preferred substrate of softshell clams (fine sediments). Grab samples collected within the Federal channel did not contain harvestable shellfish species (Pellegrino, 2003).

Chelsea River - The bottom type within the Chelsea River is a heterogeneous mix of gravel and sand, with areas of finer sediments (silt, mud, clay) (Figure 3-1). Softshell clam habitat is present along the banks but not in the channels the Chelsea River (Figure 3-9), with smaller areas of razor clam and blue mussel habitat in the upper reaches of the river. The presence of softshell clam was confirmed by one grab sample collected in the general area of this identified habitat (Massport, 2003).

Inner Harbor - Mud and clay is the predominant sediment type within the Inner Harbor (Figure 3-1). No suitable shellfish habitat is identified by MA DMF within the Inner Harbor (Figure 3-9). Blue mussel and Jonah crab were present in grab samples collected at North Jetty, just to the north of the Reserved Channel, in an area of mud and sand (Massport, 2003). Blue mussels were also present in samples from Conley Terminal within the Reserved Channel.

Lower Harbor - Suitable habitat for several shellfish species is present along the coastline of the Lower Harbor, although none is located within the Presidents Roads Ship Channel or Anchorage (Figure 3-9). Softshell clam habitat exists along almost the entire coastline of the harbor north of the channel and along the coastline and shores of the islands (*i.e.*, Long Island, Spectacle Island, Thompson Island) to the south of the channel. This habitat is interspersed with large areas of blue mussel habitat and smaller, localized razor clam habitat. Blue mussel habitat is also located just outside the Presidents Roads Anchorage and Channel at the tip of Deer Island. These habitats coincide with areas of mixed coarse and fine-grained sediment or rock (Figure 3-1). Rock crabs were present in the grab samples collected within the Presidents Roads Anchorage and Ship Channel (Pellegrino, 2003).

Life History Information - Life history information for species with habitat within the project area are presented below and summarized in Table 3-10.

Table 3-10. Life History and Habitat of Shellfish Species in the Project Area

Species	Distribution	Water Depth	Substrate Type	Feeding Strategy	Spawning	Larvae
Softshell Clam *Mya arenaria*	Labrador to South Carolina	Intertidal to subtidal (~30 ft)	Fine sediments or coarse gravel and stones	Filter feeder	Summer	Planktonic
Blue Mussel *Mytilus edulis*	Artic to South Carolina	Intertidal and shallow sub-tidal to offshore	Attached to rocks, pilings and other solid objects	Filter feeder	Almost year-round with peaks in summer	Planktonic
Razor Clam *Ensis directus*	Labrador to Florida	Bays, estuaries, shallow areas	Sand and sandy mud	Filter feeder	Summer through fall	Planktonic
Atlantic Surf Clam *Spisula solidissima*	Continental shelf waters from Gulf of St. Lawrence to North Carolina	< 240 ft	Medium sand	Filter feeder	Summer and early fall	Planktonic
Atlantic Sea Scallop *Placopecten magellanicus*	Continental shelf waters from Newfoundland to North Carolina	132-660 ft, <66 ft north of Cape Cod	Sandy	Filter feeder	Late summer and early fall	Planktonic
Rock Crab *Cancer irroratus*	Labrador to South Carolina	Intertidal north of Cape Cod, <2600 ft	All types of bottom types, rocks/crevices	Omnivorous	Summer	Planktonic
Jonah Crab *Cancer borealis*	Nova Scotia to Florida	Deeper than rock crab	Rock or mud	Mussels, snails, urchins, crabs	Summer	Planktonic

Softshell Clam: The softshell clam (*Mya arenaria*) is found along the Atlantic coast from Labrador to South Carolina and in bays and sounds in the bottom sediments of intertidal and subtidal waters up to depths of 30 feet (Newell and Hidu, 1986). Fine sediments (soft mud and sand, compact clay) are the preferred substrate of softshell clams, but they also grown in coarse gravel and stones. Spawning peaks in the summer (June through September). The planktonic larval stage of the softshell clam lasts for 12 to 14 days in the water column and then settles to the bottom, where it develops a foot and attaches to the bottom. Juvenile seed clams (5 mm long) may migrate up to several hundred yards toward shore, with movement peaking in the fall. Adult clams live in permanent burrows that are up to 16 inches deep. They feed mainly on plankton (*i.e.*, flagellates and diatoms) but can also feed on bacteria and organic detritus. Predators include birds, fish, shrimp, crabs, snails, and worms.

The softshell clam (*Mya arenaria*) is the most common commercially harvested shellfish within Massachusetts (MA DMF, 2005a). Management of the beds is under the jurisdiction of the MA DMF. Most of the productive softshell clam beds within the project area are closed, except for conditionally restricted areas near Logan Airport in North Boston Harbor and areas near the Neponset River and Dorchester Bay (Figure 3-11). The largest landings in Boston Harbor have historically come from the Airport (GBH5.2) and Snake Island (GBH5.5) locations in North Boston Harbor (Table 3-11). The largest landings in the Neponset River and Dorchester Bay area are from Carson Beach (GBH3.6). Clams are harvested and transported by licensed and bonded master diggers to a shellfish purification plant in Newburyport, where they are held for at least three days in a system supplied with clean, flowing seawater. Once the contaminants have been purged, the clams are returned to commercial harvesters for sale and consumption.

Table 3-11. Softshell Clam Landing Data in Boston Harbor for 1997 thru 2003

Area	Area Name	Location	Racks						
			1997	1998	1999	2000	2001	2002	2003
GBH5.1	North Boston Harbor	The Shores	2359	2764	5329	2837	3040	1509	62
GBH5.2	North Boston Harbor	Airport	4579.5	3832.5	2137	3108.5	3213	371.5	4635.5
GBH5.3	North Boston Harbor	Governors Island	2618	2238	1489	1414	1211	71	985
GBH5.4	North Boston Harbor	Wood Island	1857	1713	1049	759	175	80	439
GBH5.5	North Boston Harbor	Snake Island	4531	4457	3820	1955	1857	505	361
GBH5.9	North Boston Harbor	Orient Heights	NA	NA	NA	NA	344	21	0
GBH3.6	Neponset R./Dorchester Bay	Carson Beach	NA	NA	NA	NA	NA	3650	1225
GBH3.9	Neponset R./Dorchester Bay	Thompson	NA	NA	NA	NA	NA	1708	339
GBH3.10	Neponset R./Dorchester Bay	Long Island	NA	NA	NA	NA	NA	350	20

Source: Glenn Casey, MA DMF, personal communication, 2004.
Rack = industry unit of measurement equivalent to approximately 50 lbs.
NA = not available

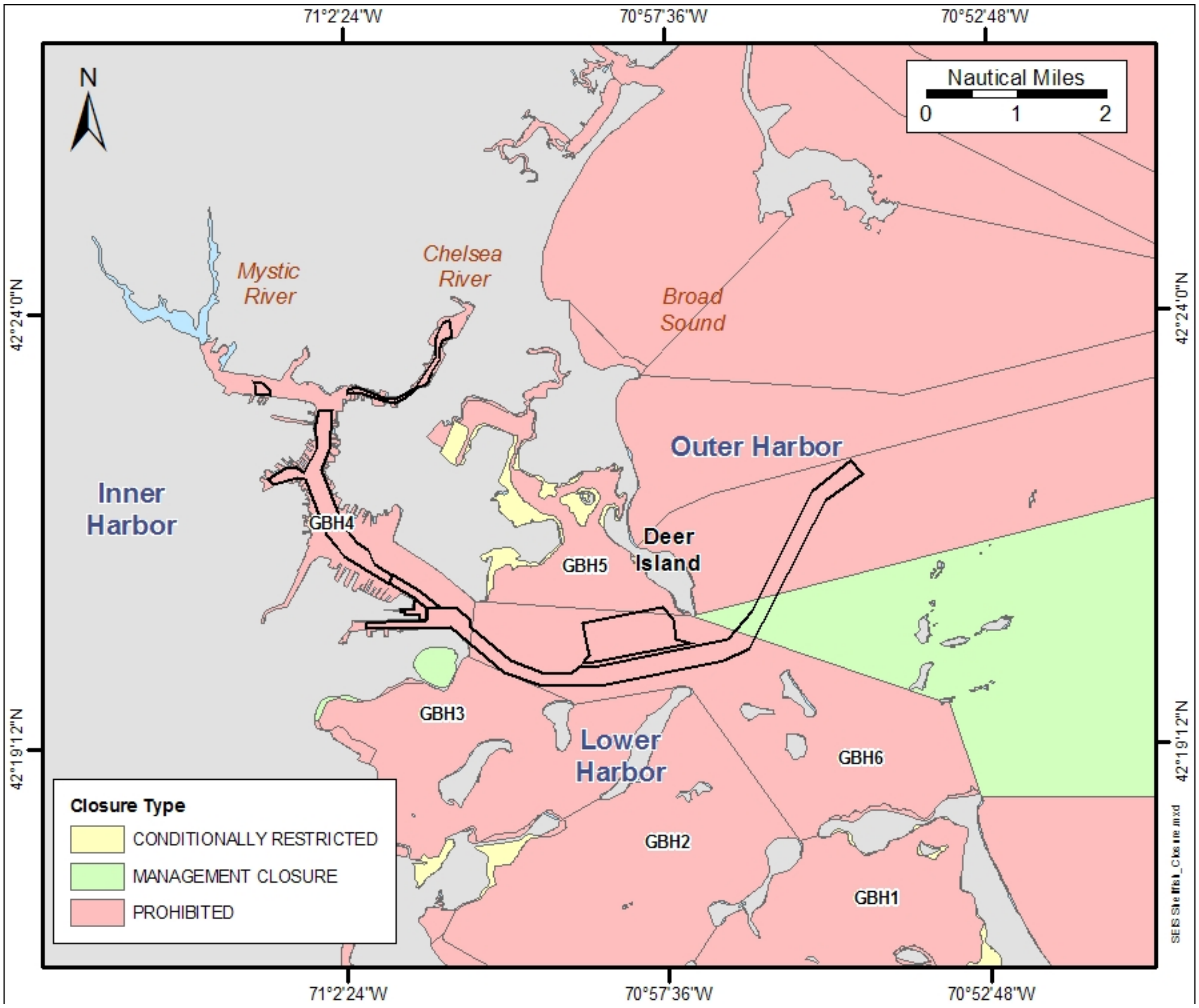


Figure 3-11. Designated Shellfish Growing Area (MA DMF, 1999)

Blue mussel: Blue mussels, *Mytilus edulis*, are distributed from the Arctic to South Carolina (Canada Department of Fisheries and Oceans, 2003a). They are found from slightly brackish estuaries to deep offshore waters but are most abundant in the intertidal and shallow subtidal zones. Mussels have fibers called byssal threads (commonly called the "beard") that are used to anchor to rocks, pilings, or other mussels. Mussels spawn between May and August, with fertilization occurring in the water column (Canada Department of Fisheries and Oceans, 2003a). Embryos become free-swimming planktonic larvae, which are present in the water column for three to four weeks. Between mid-June and late July, the larval mussel metamorphoses into a juvenile and attaches itself to a solid surface. The juvenile mussel can detach itself and change locations (either by crawling with their foot or floating in the water column) until a suitable hard substrate is found at which time the mussel permanently attaches itself and matures to an adult. Mussels can tolerate wide ranges in salinity and temperature. They are filter feeders that feed primarily on phytoplankton, as well as decomposed macrophytes or detritus. Mussel larvae are a food source for zooplankton; juvenile and adult mussels are preyed on mainly by sea ducks, starfish, crabs, and humans. They are harvested commercially from Maine to Long Island, New York (Maine Department of Marine Resources [ME DMR], 2003). Mussels can be harvested year round and are usually taken by hand with a rake or from a boat with a drag.

Razor clam: Razor clams, *Ensis directus*, are generally found in intertidal to subtidal areas from Labrador to Florida (Gosner, 1978). They are very proficient at digging into the sand to avoid predation. Only the top part of the quickly retractable siphon of the clam is exposed to filter food particles from the water. Similar to blue mussels, razor clams do not typically occur in offshore waters. They are harvested both commercially and recreationally.

Atlantic Surf Clam: The Atlantic surf clam, *Spisula solidissima*, inhabits sandy continental shelf habitats from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina (Cargnelli *et al*., 1999). The largest concentrations of Atlantic surf clams usually occur in well-sorted, medium sand but may also occur in fine sand and silty-fine sand. Surf clams inhabit waters from the surf zone to a depth of 420 ft but are more common at depths less than 240 ft. Areas of coarse grain size (*i.e.*, pebbles or cobbles) are virtually devoid of surf clams (Murawski, 1979). Atlantic surf clams are filter feeders that pump water through their siphons over the gills to trap food, mainly plankton. Their planktonic larvae remain in the water column for about three weeks. Many predators, including snails, shrimp, crabs, and fish (haddock and cod), feed on surf clams (Cargnelli *et al*., 1999). Commercial concentrations in Massachusetts are found primarily on Georges Bank. Recreational fishing is insignificant.

Sea scallop: The sea scallop, *Placopecten magellanicus*, occurs in the western North Atlantic continental shelf waters from Newfoundland to North Carolina (Hart, 2001). North of Cape Cod, populations are generally scattered in shallow water less than 66 feet deep and are most often associated with sandy sediments. Spawning occurs in late summer/early fall, and scallop larvae are present in the water column for four to eight weeks before settling to the bottom. The commercial fishery for scallops occurs year round, with dredges and otter trawls used as the primary harvesting equipment. Sea scallops are most heavily fished on Georges Bank and off the New Jersey coastline between 132 and 330 ft in waters cooler than 20 ºC. Recreational fishing is insignificant.

Cancer Crabs: *Cancer* sp. crabs are one of the most common shallow-water crabs in New England waters (Gosner, 1978). Rock crabs (*Cancer irroratus*) are distributed from Labrador to South Carolina, and north of Cape Cod they are found in intertidal areas. Rock crabs prefer rocky habitat but can be found on all types of bottoms. Jonah crabs (*Cancer borealis*) are usually found deeper than rock crabs and prefer exposed, rocky habitat, though they are common on muddy substrates in deeper waters (Gosner, 1978; Estrella, 2003). Egg-bearing females live in pits that they dig in soft sediments (Canada Department of Fisheries and Oceans, 2003b). Breeding occurs in the fall just after the females have mated. Male crabs molt later in the winter. Cancer crabs produce hundreds of thousands of eggs, which they lay and keep under their abdomen for about one year. The eggs hatch into planktonic larvae in the summer, which remain in the water column from mid-June to mid-September. In the fall, the larvae molt into small crabs (megalops) and settle both in cobble and sand (Palma *et al*. 1998). Juvenile crabs (less than 0.6 inches carapace width) concentrate in sheltered areas in shallow depths (Canada Department of Fisheries and Oceans, 2003b). Rock crabs are omnivorous and are an important prey item for lobsters. Cancer crabs are currently a by-catch fishery with modest consumer demand (Estrella, 2003).

Summary - Recent data describing the distribution of shellfish in Boston Harbor are very limited. Potential habitat for several commercially and recreationally important species of shellfish (softshell clam, blue mussels, razor clams, and sea scallops) occur along the banks of the Chelsea and Mystic Rivers and along the coastlines of the Lower Harbor. The presence of softshell clam, blue mussel, rock crab, and Jonah crab was confirmed by grab samples collected within the project area but in very low densities (Pellegrino, 2003; Massport, 2003). Of these species, softshell clam is the most common commercially harvested shellfish within Massachusetts and Boston Harbor. Most of the productive softshell clam beds within the project area are closed, except for conditionally restricted areas near Logan Airport in North Boston Harbor and areas near the Neponset River and Dorchester Bay.

Lobster

With the decline of cod and other groundfish fisheries, the American lobster (*Homarus americanus*) has emerged as the most economically important fishery in Massachusetts State waters (Estrella and Glenn, 2001; Dean, *et al.*, 2005), where it has been found to occur from the intertidal zone offshore to water depths of 2,360 feet (ft) (MacKenzie and Moring, 1985). This section describes the life history, habitat requirements, and fishery data for lobster within the affected environment. Other commercially and recreationally important species of shellfish are discussed in the above section.

Life History Information - Like many other marine crustaceans, the life history of this animal includes several phases, each having specific habitat requirements. Spawning generally occurs from May to October and peaks in July, when water temperatures reach approximately 20º C. Eggs are carried by the female for 9 to 12 months and then hatch into a prelarval stage. After hatching, lobsters begin a short, pelagic larval phase, which lasts for three molts over the span of approximately one month. Later-stage larvae are capable of maintaining position in the water column and migrating vertically to take advantage of sub-surface currents (Harding *et al.*, 1987). However, there are differences in larval behavior, depending on whether the larvae are located in offshore or coastal waters. Coastal larvae tend to concentrate in the upper 6.5-10 feet of the water column. In contrast, offshore larvae exploit a greater range of depths, up to about 98 feet (Harding *et al.*, 1987).

The postlarvae settle sometime between the middle and end of the stage prior to molting, the timing of which is dependent upon environmental conditions (Scarratt, 1973; Cobb *et al.*, 1989). Environmental cues may influence settlement choices. Of these factors, a thermal gradient of 4-5°C appears to be a significant barrier to postlarvae because they are disinclined to swim from the warm surface waters through the thermocline[1] into the cold waters below (Boudreau *et al.*, 1992). Because of this reluctance to move from warm surface waters to cold waters, postlarvae generally remain in warm, shallow, inshore waters where such gradients are absent (Boudreau *et al.*, 1992; Wahle and Steneck, 1991). This temperature avoidance behavior may explain the lack of recently settled juvenile lobsters in deep water Maine cobble habitats that are considered "prime habitats" for protection against predators (Wahle and Steneck, 1991; Wilson, 1998). Such a lack of postlarvae in deep cobble habitats led Wahle and Steneck (1991) to agree with the hypothesis that lower temperatures (<15°C) and thermal gradients may inhibit settlement, as originally proposed by Huntsman (1923).

Once settling is complete, the postlarva molts into the first juvenile stage. This stage, as well as subsequent stages within the first year, is commonly referred to as a young-of-the-year (YOY) lobster, or is included within the broader categorization of "early benthic phase (EBP) lobster," which typically extends past the first year and through the third year of the benthic

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[1] A layer below the warm surface water where there is a rapid change in temperature with depth. This layer provides a separation between warm surface waters and cold, deeper waters where temperatures change, but not as rapidly.

lobster's life[2]. YOY lobsters (<15 mm carapace length [CL]) typically move very little. If movements do occur, they tend to be within contiguous cobble coverings (Lavalli and Lawton, 1996). Shallow, inshore populations of YOY lobsters benefit from warm coastal temperatures, which allow them to grow rapidly and attain larger sizes by the end of their first benthic season. Second year lobsters, also known as early benthic phase juveniles or vagile juveniles (Lavalli and Lawton, 1996), typically move about more frequently than YOY lobsters, but still remain localized within their settlement neighborhood, as evidenced by their residence in the same habitats as YOY (Wahle and Steneck, 1991). Here, they also benefit from shallow, warm waters in the spring and summer months, which permit rapid growth. When juveniles reach a size of 40 mm CL (the upper size limit of EBP lobsters) or larger, their movements tend to increase because the need for shelter-providing habitats is reduced (Lavalli and Lawton, 1996).

Although all benthic stages of lobsters are capable of modifying substrates, their distribution in the benthos is not random. Typically, postlarvae settle into shelter-providing habitats and are found in the highest densities in cobble (Wahle and Steneck, 1991). EBP lobsters from 5 to 40 mm CL are most abundant in cobble-boulder habitats (Wahle and Steneck, 1991; Wahle, 1993; Hudon, 1987), salt marsh peat reefs (Able *et al.*, 1988), and the intertidal zone (Cowan *et al.*, 2002). Young-of-the-year (YOY) lobsters (<10 to 12 mm CL) at most sites are typically found in lower densities than larger juveniles (>10 to 12 and < 40 mm CL) (Incze and Wahle, 1991; Wahle and Incze, 1997), which are more motile and tend to leave their original settlement areas. Despite the higher density in cobble-boulder habitats of all EBP lobsters that are less than 40 mm CL, there is extreme variation in density from region to region (Cobb *et al.*, 1999; Incze and Wahle, 1991; Incze *et al.*, 1997; Wahle and Steneck, 1991; Wahle, 1993). The highest densities of EBPs were reported in cobble-boulder sites in Maine; much lower densities were reported from similar substrates in New Hampshire, northern and southern Massachusetts, and Rhode Island (Cobb *et al.*, 1999; Incze *et al.*, 1997; Wahle and Steneck, 1991; Wahle, 1993; Wahle and Incze, 1997). Lower densities of EBPs are also reported by depth gradient, with the highest densities being found between 5 and 10-meter depths (Wilson, 1998).

Molting (i.e., shedding of the external shell) is the process that allows lobsters to grow. During the spring and summer (May through September), about 30 to 50 percent of the offshore lobster population moves into shallow water to molt and mate (Cobb and Phillips, 1980). This migration behavior is probably initiated by temperature, since the shallower bottom waters in the inshore areas provide more suitable water temperatures for molting and mating than the cooler waters over the outer shelf and upper slope. Estrella and Morrissey (1997) also observed that sublegal (<83.3 mm CL) and legal size (>83.3 mm CL) females with no eggs moved significantly less than egg-bearing female groups, suggesting that egg-bearing female lobsters need to migrate to, and stay in, shallow warmer waters to provide the appropriate temperatures for egg development. In late fall and early winter, when inshore water temperatures cool, the offshore migrants return to the outer continental shelf.

Juvenile and adult lobsters are omnivorous (i.e., they will eat whatever food is available) and forage mainly at night (Harding, 1992). Their diet generally includes a variety of bottom-dwelling invertebrates, such as crabs, polychaetes, mussels, periwinkles, sea urchins, and sea stars.

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[2] EBP lobsters range in size from 5 to 40 mm CL and are subdivided into several different juvenile age ranges: YOY (between 5 to 12 or 15 mm CL, depending on researchers and location), second year or vagile juveniles (~15 to 20-25 mm CL) and emergent juveniles (between 20-25 and 40 mm CL). Sizes may be adjusted by researchers working in different regions, as colder waters (such as those found in Maine) may decrease growth rates compared to warmer water regions, such as southern Massachusetts, Rhode Island, and Connecticut.

Distribution of Lobster and Their Habitat within the Project Area - Published scientific literature and results from larger scale lobster studies conducted by the Massachusetts Division of Marine Fisheries (MA DMF) may be used to predict the distribution of lobster and their various life stages within the project area based on the substrate present. In general, lobster habitats are highly variable (Cooper and Uzmann, 1980). Inshore habitats used by populations of EBP juveniles, adolescents, and adults include mud, cobble, bedrock, peat reefs, eelgrass beds, sand, and for smaller individuals, the intertidal zone (Thomas, 1968; Cooper, 1970; Cobb, 1971; Cooper *et al.*, 1975; Hudon, 1987; Able *et al.*, 1988; Heck *et al.*, 1989; Wahle and Steneck, 1991; Lawton and Robichaud, 1992; Cowan *et al.*, 2002). YOY (EBPs, < 15 mm CL) are typically restricted to shelter-providing habitats that protect them from predators (Lavalli and Barshaw, 1986; Hudon, 1987; Johns and Mann, 1987; Barshaw and Lavalli, 1988; Able *et al.*, 1988; Wahle and Steneck, 1991; Wahle and Steneck, 1992). Larger juveniles may be less susceptible to inshore predators and, thus, are able to exploit a wider range of habitats, including those less likely to provide ready-made shelter, and habitat that allows them to build shelters (e.g., mud) (Cobb, 1971; Berrill and Stewart, 1973; and Botero and Atema, 1982). Adolescents (sub-legal lobsters) and adults (mostly legal-sized lobsters), particularly those that remain in shallow coastal waters, have fewer predators and are found in featureless substrates, such as sand and fine-grained mud (Cooper and Uzmann, 1980). While shelters are necessary for the purposes of molting and mating (Tremblay and Smith, 2001; Karnofsky, *et al.*, 1989), these larger lobsters show little shelter fidelity within a home range over a period of several days, except during over-wintering months (Watson, 2005). Thus, there is a trend of increased ability to exploit all available habitats, both featureless and shelter providing, as the size of a lobster increases.

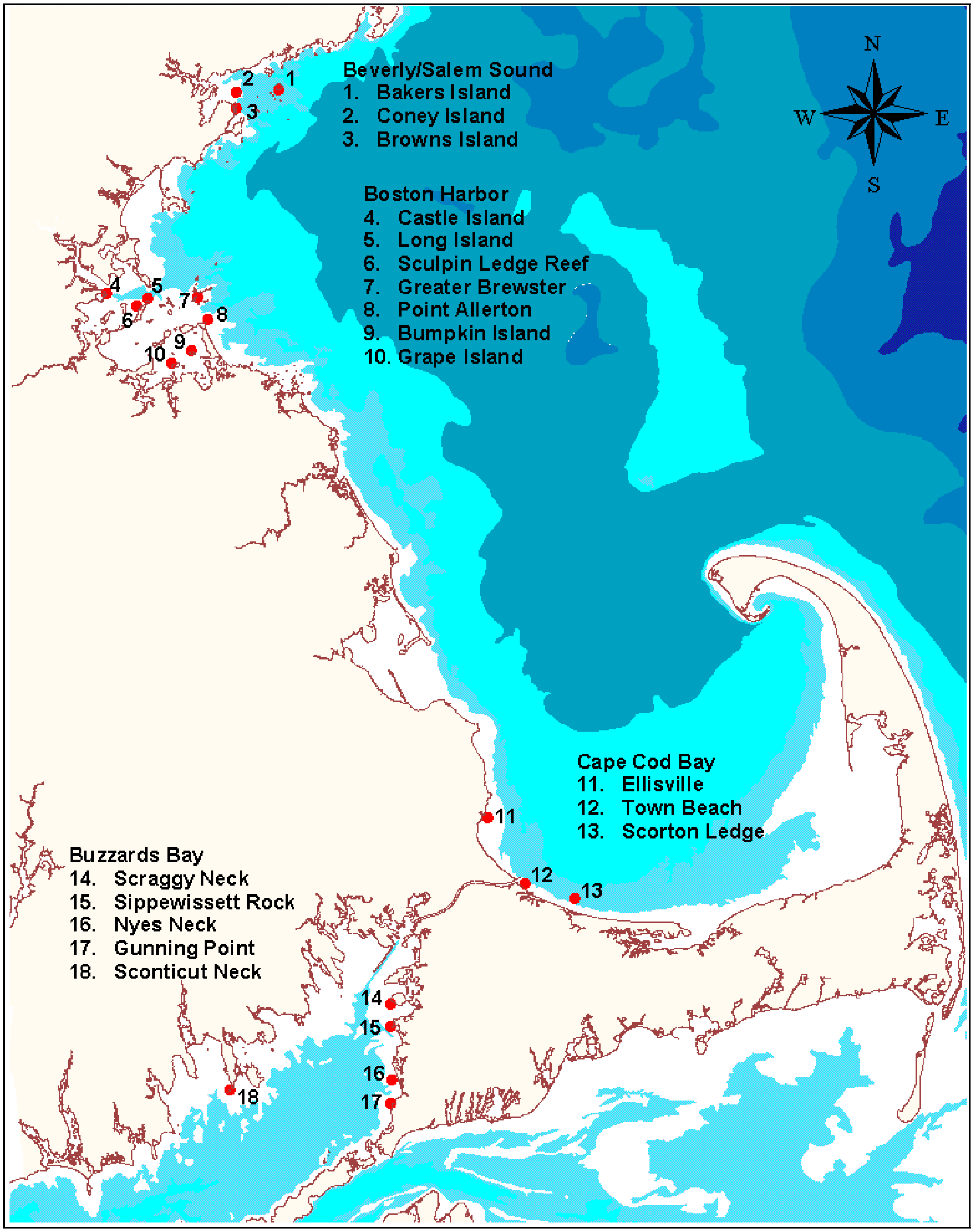
In 1995, MA DMF began a suction-sampling program to monitor densities of newly settled postlarvae and subsequent YOY. The goals of this program are to document important nursery habitat and develop a lobster settlement index to better understand environmental factors influencing population trends. Currently 18 sites are sampled in Massachusetts, including seven within the Boston Harbor/Massachusetts Bay area, spanning from the Inner Harbor to the Outer Harbor and southwards towards Cohasset (Figure 3-12). These sites were selected on the basis of the presence and quality of appropriate substrate at each location, as well as exposure to prevailing summer winds to ensure wind driven larval transport. Table 3-12 lists the EBP lobster sampling sites within Boston Harbor and the substrate and depth at each sampling location.

Table 3-12. EBP Lobster Sampling Site Characteristics

Location	Sampling Site	Substrate	Depth
Inner Harbor	Castle Island (located 164 ft south of green can 5A, at a distance of 656 to 984 ft from the shore)	cobble interspersed with kelp holdfasts	10–20 ft
	Long Island (located 246 ft from shore off the southeast corner of the island)	cobble bottom with moderate kelp cover that changes to mud/gravel toward shore	12-20 ft
	Sculpin Ledge Reef (located ¼ mile south of the Sculpin Ledge Channel)	"man-made" rip-rap rock approximately 2 to 6 inches in diameter, stacked 3 to 4 layers deep	NA
	Bumpkin Island	cobble mixed with loose shell rubble and sparse macroalgae	10-15 ft
	Grape Island (located 246 ft from shore off the northwest corner of the island),	gravel/mussel shell rubble with small patches of cobble	10-15 ft
Outer Harbor	Greater Brewster Island (located 328 ft from shore off the southeast portion of the island)	cobble interspersed with boulders and moderate macroalgae cover	15-20 ft
	Point Allerton (located 492 ft from shore off the eastern-most portion of the point)	large boulder/sand substrates with moderate patches of cobble and heavy to moderate macroalgae cover	15-20 ft

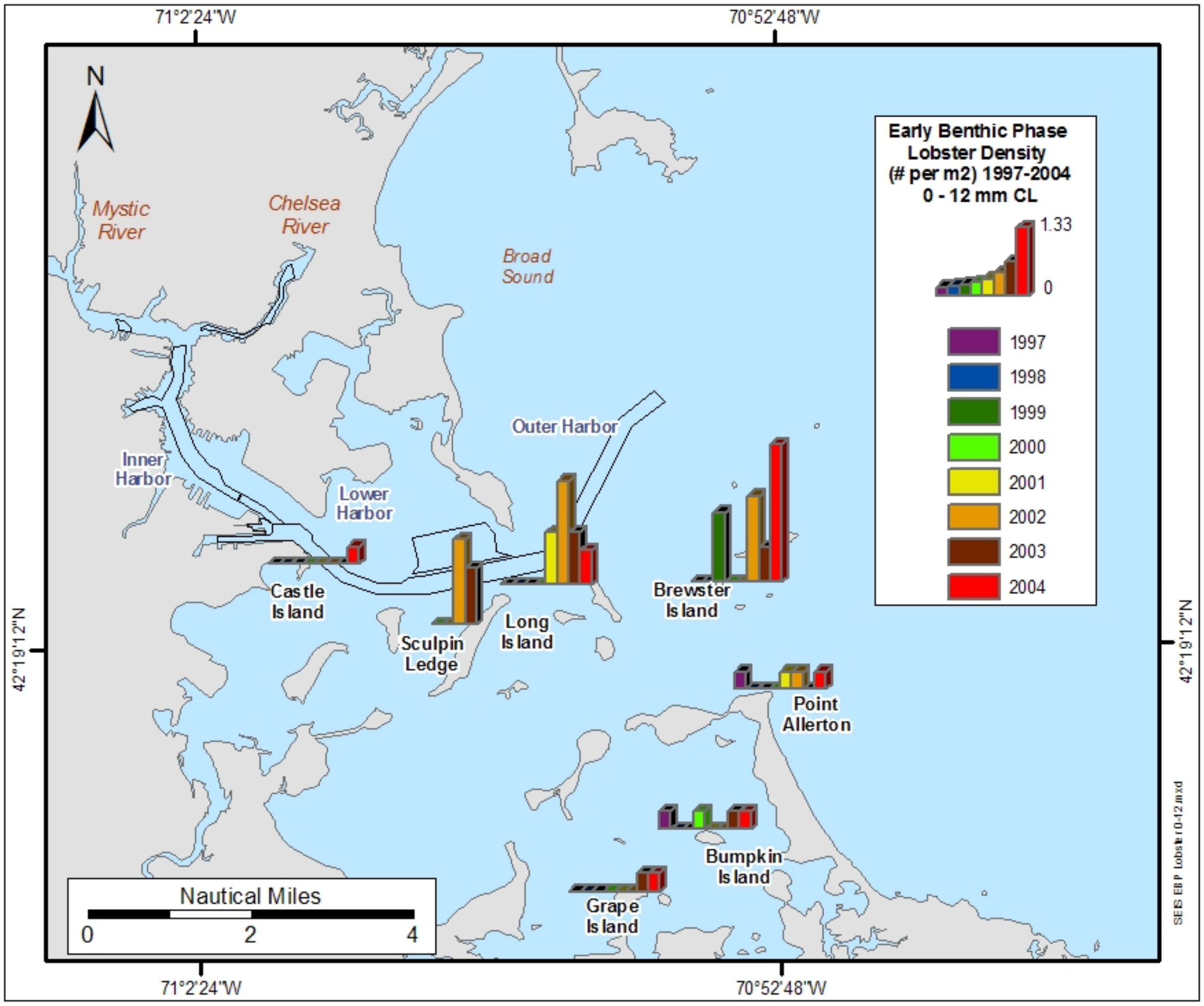
NA = not available

While there is great interannual variability in densities of YOY (up to 12 mm CL) among the sites within Boston Harbor, most sites in the Outer Harbor have shown a stable (Bumpkin Island, Point Allerton, Grape Island) or increasing density (e.g., Brewster Island in the Outer Harbor) (Figure 3-13). The density of early benthic phase lobsters from 0 to 40 mm CL appears to increase at sites near the Boston Harbor navigation channel and decrease at sites south of the channel (Figure 3-14). However, this increase appears to be the result of the habitat type at these locations. At the sites closer to the channels, the bottom type is predominately cobble where the southern sites are gravel, sand, or larger boulder. As the EBP appear dependent on the sediment type, this may explain the difference in densities.



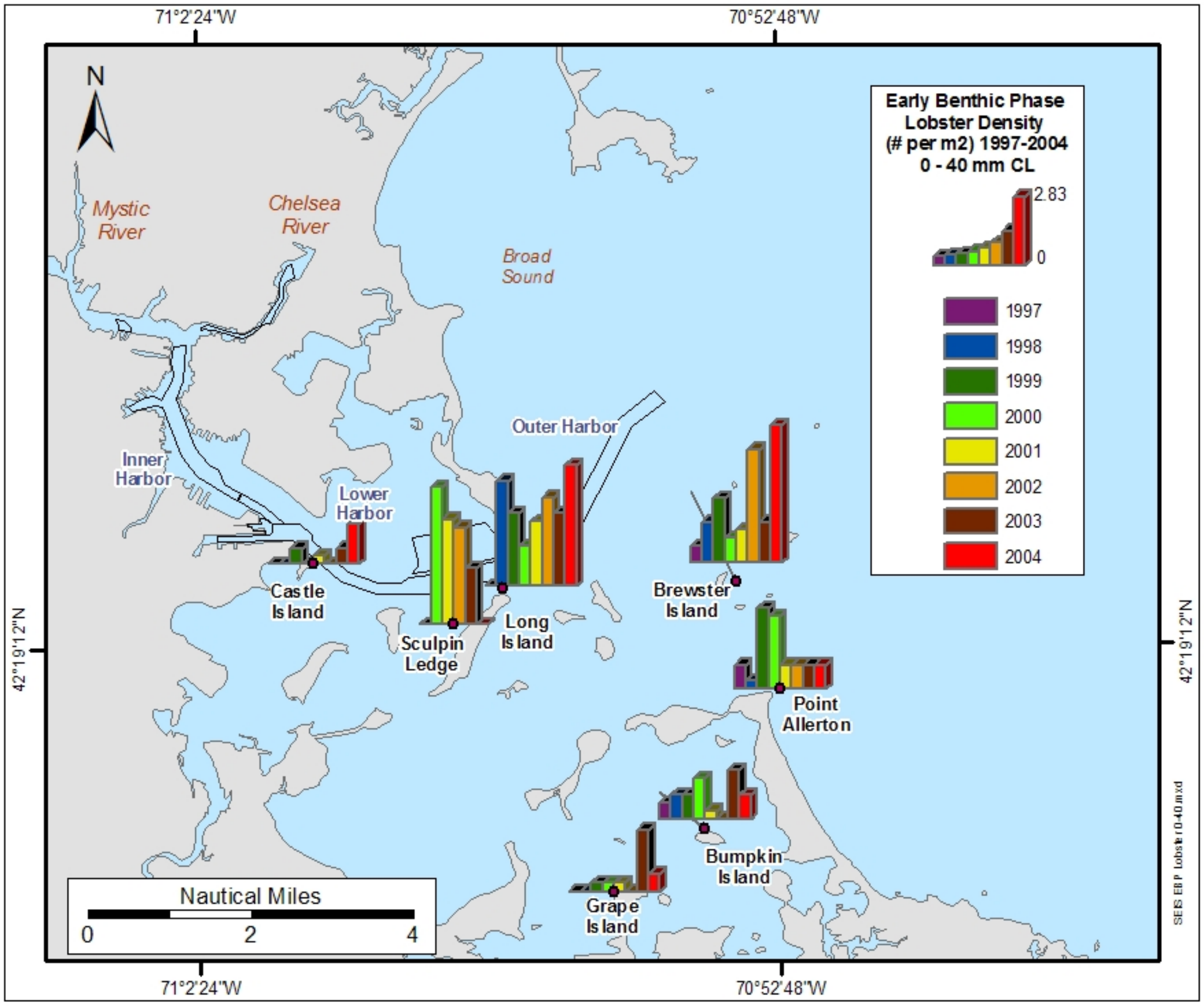
Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.

Figure 3-12. EBP Sampling Sites within Massachusetts State Waters



Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.
Note: Sculpin Ledge was not sampled until 2000, and it was not sampled in 2004 due to inclement weather. Castle and Grape Islands were not sampled until 1999.

Figure 3-13. Average Annual Densities of EBP Lobsters (0-12 mm CL) for Sampling Sites within Boston Harbor, 1997-2004

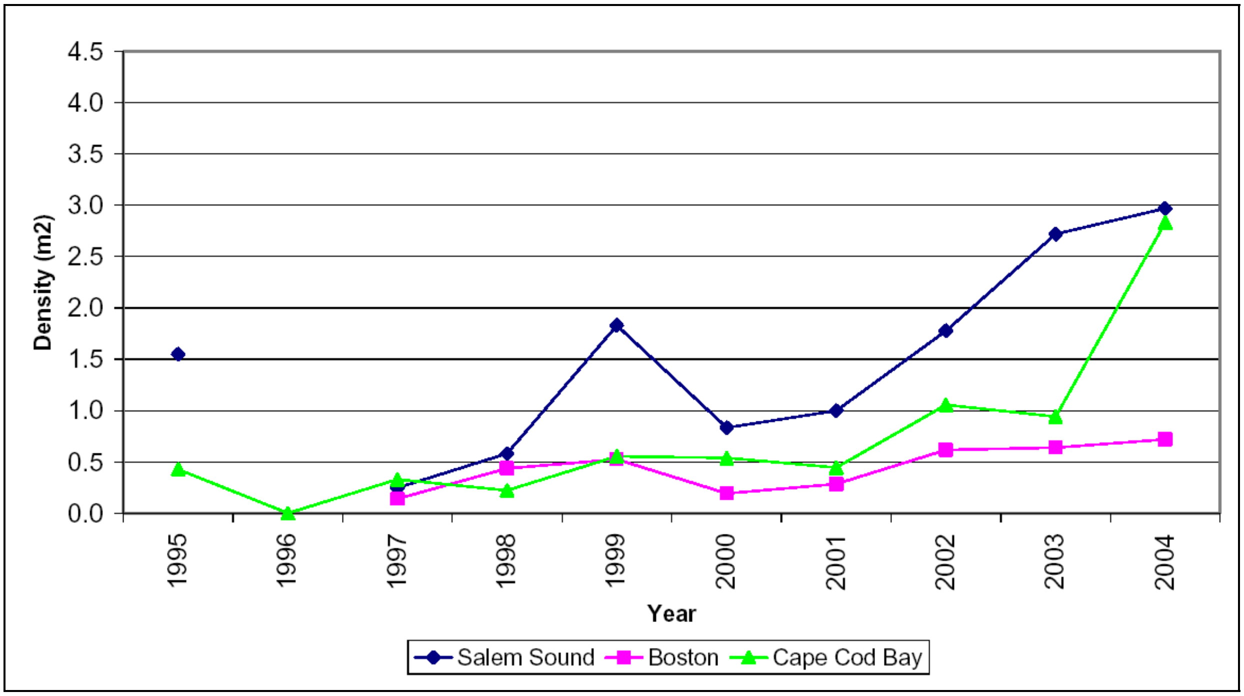


Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.
Note: Sculpin Ledge was not sampled until 2000, and it was not sampled in 2004 due to inclement weather. Castle and Grape Islands were not sampled until 1999.

Figure 3-14. Average Annual Densities of EBP Lobsters (0-40 mm CL) for Sampling Sites within Boston Harbor, 1997-2004

The small increases in the larger juveniles (12-40 mm CL) in Boston Harbor could be due to "walk-ins[3]" from other settlement sites, as well as from growth of settlers in the previous year. Although there are some increases in average densities of EBPs within the harbor, the rate of increase is significantly lower than the multi-fold increase in Salem Sound and Cape Cod Bay (Figure 3-15). Harbor densities are likely dependent on surface currents during the months when larvae and postlarvae are present in the water column, and/or to the numbers of resident, ovigerous (i.e., egg-bearing) females within the harbor (which have also been slowly increasing during this same time period). Such surface currents may affect the Boston Harbor region differently from Salem Sound and Cape Cod Bay and, thus, may impact EBP densities.

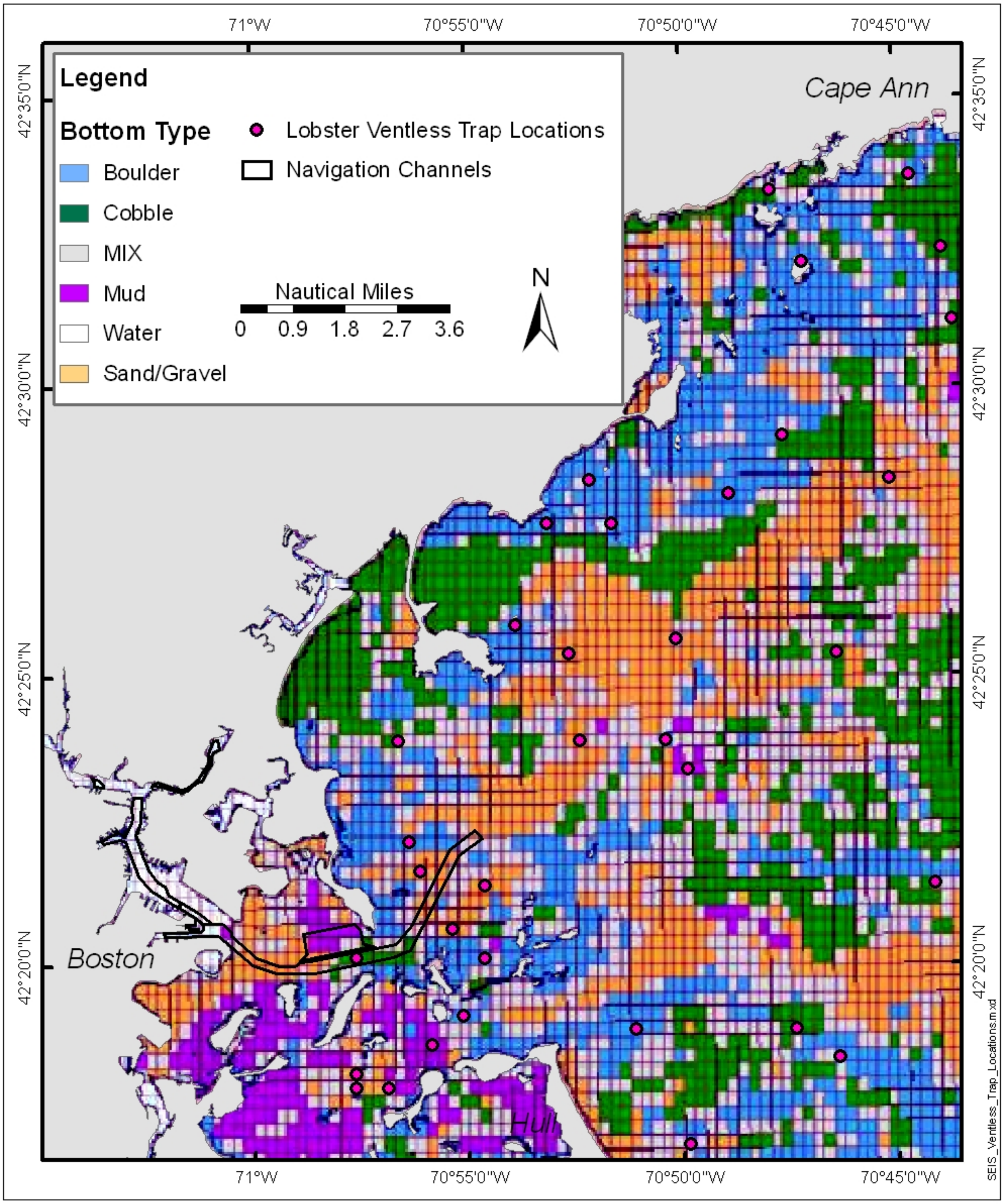
[3] The term "walk-in" refers to juvenile lobsters that are greater than 12-15 mm CL and more mobile; they tend to be more vagile in their movements and can move from site to site over short distances. Thus, if a particular settlement site becomes saturated, the larger juveniles can fan out from that site, immigrating to non-saturated sites. This movement pattern will result in different densities for YOY (0-12 mm CL) versus larger EBPs (12-40 mm CL), as is seen in the Boston Harbor sampling program.



Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.

Figure 3-15. Densities of EBP lobsters (0-25 mm CL) in the Massachusetts Portion of the Gulf of Maine

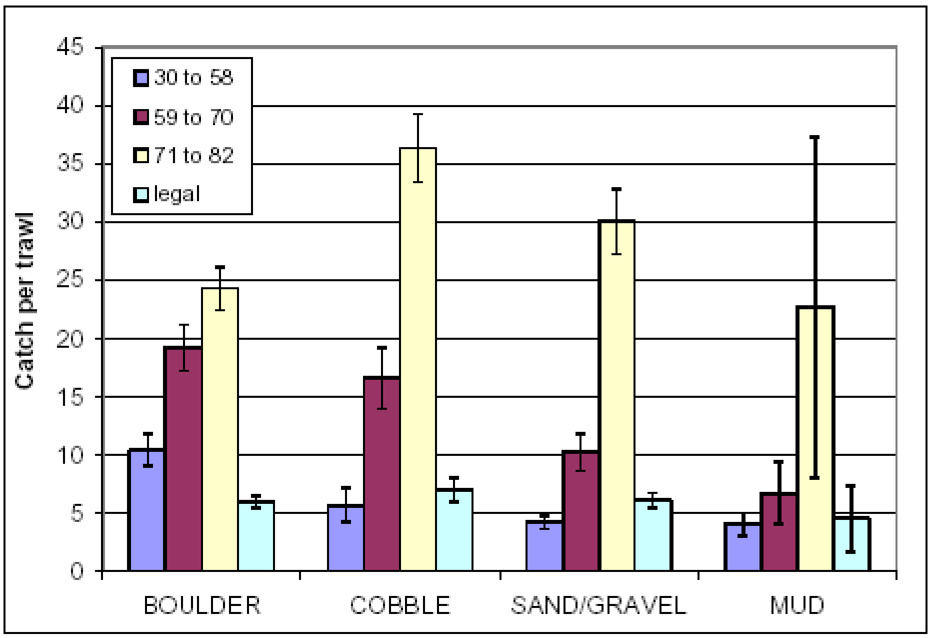
In an ongoing ventless trap study conducted by MA DMF, efforts are underway to characterize the importance of substrate type and depth to lobster abundance and size distribution (Glenn *et al.*, 2005). Fixed stations within Massachusetts Bay (including several in Boston Harbor; Figure 3-16) were sampled for the first time during a pilot study in 2004 and are currently being sampled for a multi-year survey. Sampling occurs twice monthly from May through November aboard commercial vessels using a six-trap haul, in which vented and ventless traps are alternately strung on the trawl line. The sampling involves 80 randomly selected, but fixed, stations in Massachusetts Bay with each stratum (depth and substrate) represented by at least seven stations. No sampling is done directly in the Boston Harbor navigation channel because the traps can only be recovered by grappling without buoys present to mark their location, and thus there is great potential for loss of these trawl lines and data. In addition, lobstering is not allowed within the Federal channels because it is a hazard to navigation. Instead, several stations that are in close proximity to the channel are sampled.



Source: Glenn *et al.*, 2005.

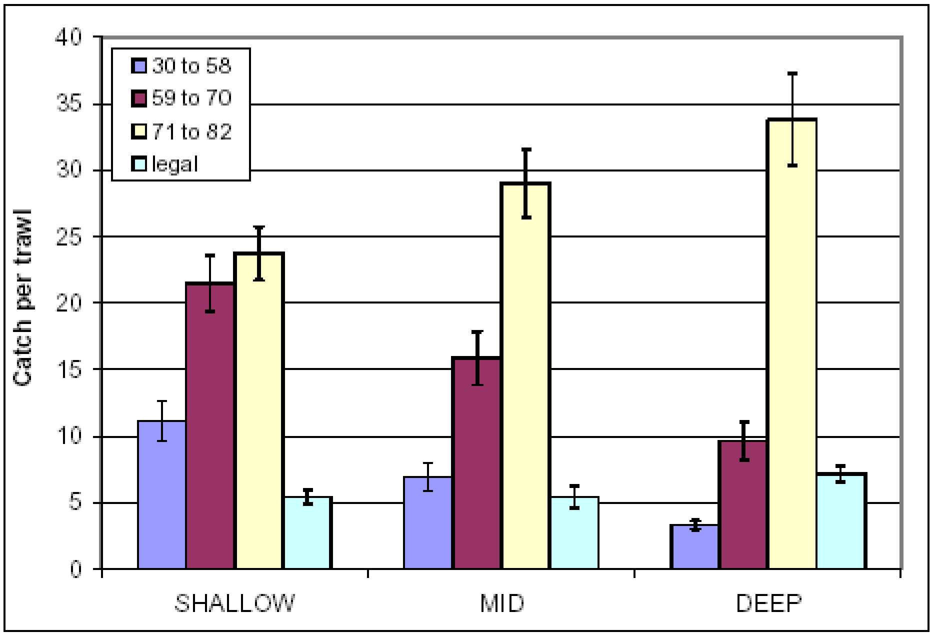
Figure 3-16. MA DMF Massachusetts Bay Ventless Trap Study Area Showing the 2005 Sample Locations and Strata

Data from the October through November 2004 ventless trap pilot study (16 sampling trips, 40 stations, 3 depth strata, 4 substrate strata for 936 trap hauls) provided initial information on the size distribution of lobsters in various types of bottom habitats in the Massachusetts Bay/Boston Harbor area. As expected from previous studies, juvenile (30-58 mm CL) and adolescent (59-70 mm CL) lobsters were more common in the shelter-providing habitats of boulder and cobble than in sand/gravel or mud (Figure 3-17), and were more common in shallow waters (0-15 m depth) (Figure 3-18). Again, these data reflect the needs of smaller juveniles for shelter-providing habitats that offer protection against predators. The data for sub-legal sized adult lobsters (71-82 mm CL) also shows a preference for boulder, cobble, and sand/gravel, habitat over mud. This size lobster is also more abundant than legal-sized adult lobsters (> 83 mm CL), indicative of the highly exploited nature of this resource (Glenn *et al.*, 2005). Both of these larger size classes of lobsters have fewer inshore predators than do the smaller class size lobsters and, thus, fewer restrictions in habitat usage.



Source: Glenn *et al.*, 2005.
Note: Bars represent ± one standard error.

Figure 3-17. Catch-per-Trawl During the Ventless Trap Study of Four Size Classes of Lobster by Sediment Type: Juveniles (30-58 mm CL), Adolescents (59-70 mm CL), Sub-Legals (71-82 mm CL), and Legal (>83 mm CL)



Source: Glenn *et al.*, 2005.
Note: Bars represent ± one standard error.

Figure 3-18. Catch-per-Trawl During the Ventless Trap Study of Four Size Classes of Lobster by Depth: Juveniles (30-58 mm CL), Adolescents (59-70 mm CL), Sub-Legals (71-82 mm CL), and Legal (>83 mm CL); Shallow, 0-15 m; Mid, 16-30 m; Deep, >30 m

The non-depositional sedimentary environments of Boston Harbor and Massachusetts Bay consist of subtidal, exposed bedrock, glacial drift, and mixed deposits from coastal–plains containing boulder fields to gravelly sand (USGS, 1999a; see Figure 3-1). These sediment types are found in high energy areas and typically occur within the harbor near the mainland, along insular (isolated island) shorelines, harbor approaches, and over scattered knolls and ridges. Depositional sedimentary environments are fine-grained muddy sand or muds and are typical in weak bottom currents (USGS, 1999a; see Figure 3-1). Sediment reworking environments are characterized by sandy-gravels to muds and are common where bottom currents fluctuate to alternatively erode and deposit the sediments. The navigation channel passes through depositional areas (Inner Harbor, Mystic and Chelsea Rivers), sediment reworking areas (Lower Harbor in the eastern portion and the Outer Harbor), and erosional areas (Lower Harbor in the western portion). Sedimentary environments in all of these areas appear to consist predominantly of silt, clay, mud, sand, and gravel (see Figure 3-1). The IHMDP is located in the shallow depth and would have tend to have less sub-legals and legal size lobsters than in the outer harbor (Figure 3-17).

Populations of EBP lobsters less than 12 mm CL are known to exist in high densities just outside the navigation channel and along island coastlines. Here, they utilize cracks within the bedrock, boulders/cobble, and rocks within glacial drift for their shelter-providing habitat. The depth and bottom substrate of the navigation channel may restrict habitat exploitation by EBPs, which prefer shallower, non-depositional habitats outside of the footprint. EBPs lobsters are found in very high densities in the intertidal zone, where salinity varies widely. The presence of these high densities would indicate there are no recruitment impacts from salinity gradients within the Inner Harbor.

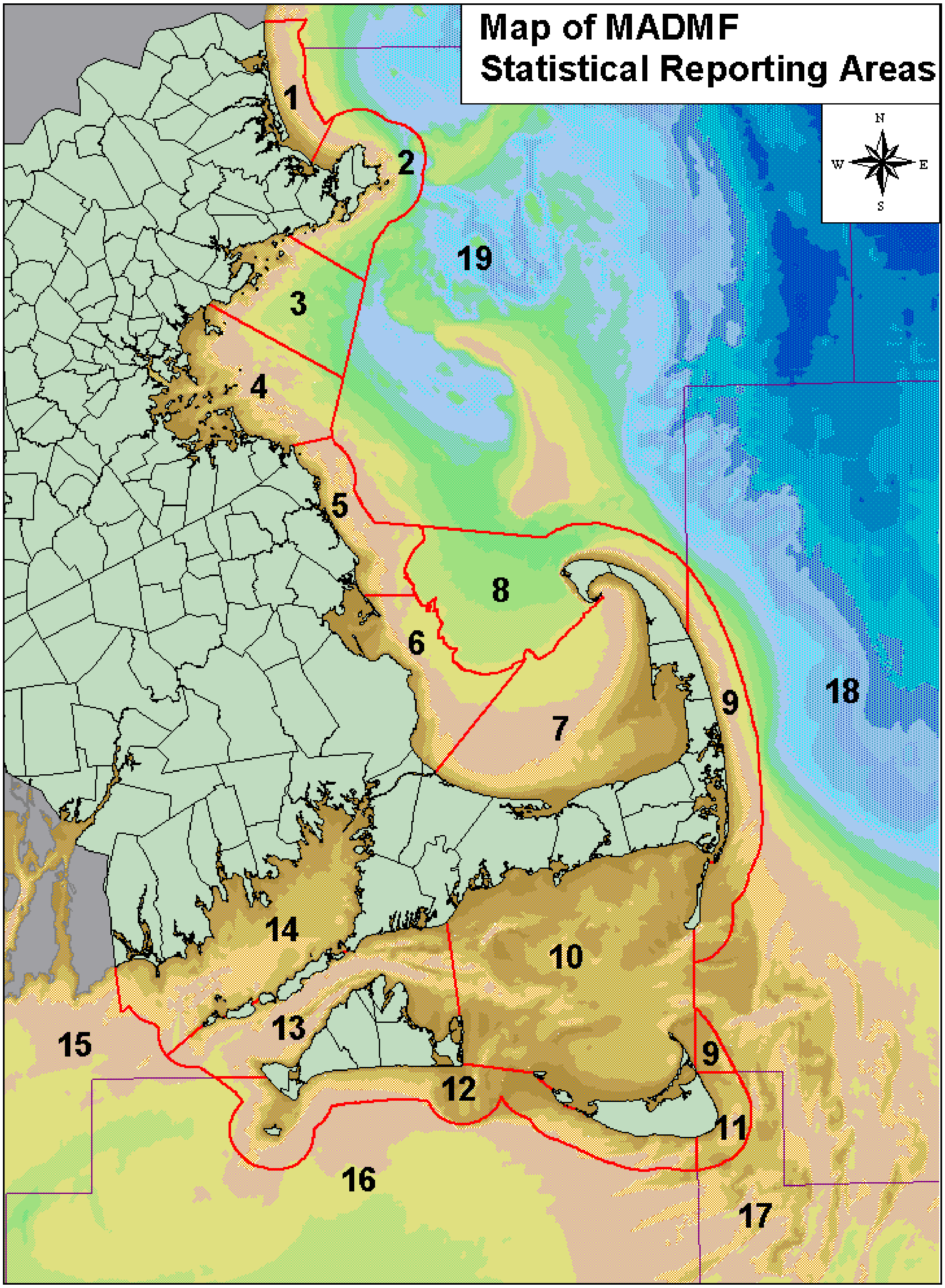
The other size classes of lobsters (i.e., larger juveniles [>12 mm CL], sub-legal sized lobsters [> 30 mm CL], and adults) are capable of utilizing all of the described habitats in the navigation channel (see Figure 3-1), as shown in the ventless trap study by MA DMF, and are found in all of these environments in Boston Harbor. Within the planned dredge footprint for the navigation channel, both non-depositional and depositional environments exist; therefore, lobsters of these larger class sizes are likely to exploit the habitats in the same manner as they are exploiting the habitats outside of the planned dredge footprint.

State-Managed Lobster Fishery - In response to a need for a cohesive management plan for sustainable fisheries, the territorial waters of Massachusetts (within the 3-mile territorial limit) have been subdivided into 14 areas, while Federal waters have been subdivided into 12 additional areas, for a total of 26 State-managed areas (Dean, *et al.*, 2005; Figure 3-19). These State-managed areas are used to issue lobster permits, which are divided into four classes: coastal commercial (within State territorial waters only), offshore commercial (within Federal territorial waters only), seasonal commercial (within both State and Federal waters, but limited to 25 traps total during the period June-September), and recreational (collected by SCUBA or via 10 traps, but catch cannot be sold) (Dean, *et al.*, 2005). Commercial fishers are required to report the number and value of their fishing gear, which is used by the State to calculate effort by home port. Therefore, data referring to number of fishers, number of pots fished, and numbers of boats are presented by home port; otherwise, data are reported for the specific State-managed area where the fishing occurred (i.e., port of landing). The poundage of lobster landed is also reported by the port of landing (Dean *et al.*, 2005) and by the specific State-managed area where traps were hauled (Robert Glenn, personal communication, June 2005). All data reported to the State as the actual number of lobsters landed, rather than poundage, is converted to weight by applying a conversion factor of 1.27 lbs per lobster (Dean, *et al.*, 2005).

The area of interest related to the Boston Harbor Inner Harbor Maintenance Dredging consists of a sub-region within the State-managed Area 4, which includes the Boston Harbor Federal Navigation Channel. This area is bounded to the east by the State territorial line, to the north by Red Rock, Lynn, and to the south by Strawberry Point, Cohasset (MA DMF, 2000; Figure 3-19).

For the years 2001 through 2003, Area 4 ranked second in the State only to Area 2 (Gloucester/ Cape Ann region) in terms of coastal harvest; it ranked third in the State from 2001-2002 for total territorial harvest[4] behind both Areas 2 and 6 (Plymouth region) (Dean, *et al.*, 2005; 2004; 2002). Prior to 2001, Area 4 ranked first in the State for coastal harvest and second to fourth for total territorial harvest. Although historically one-third of the State's entire coastal harvest comes from Area 4 currently only one-fifth of the coastal harvest comes from Area 4.

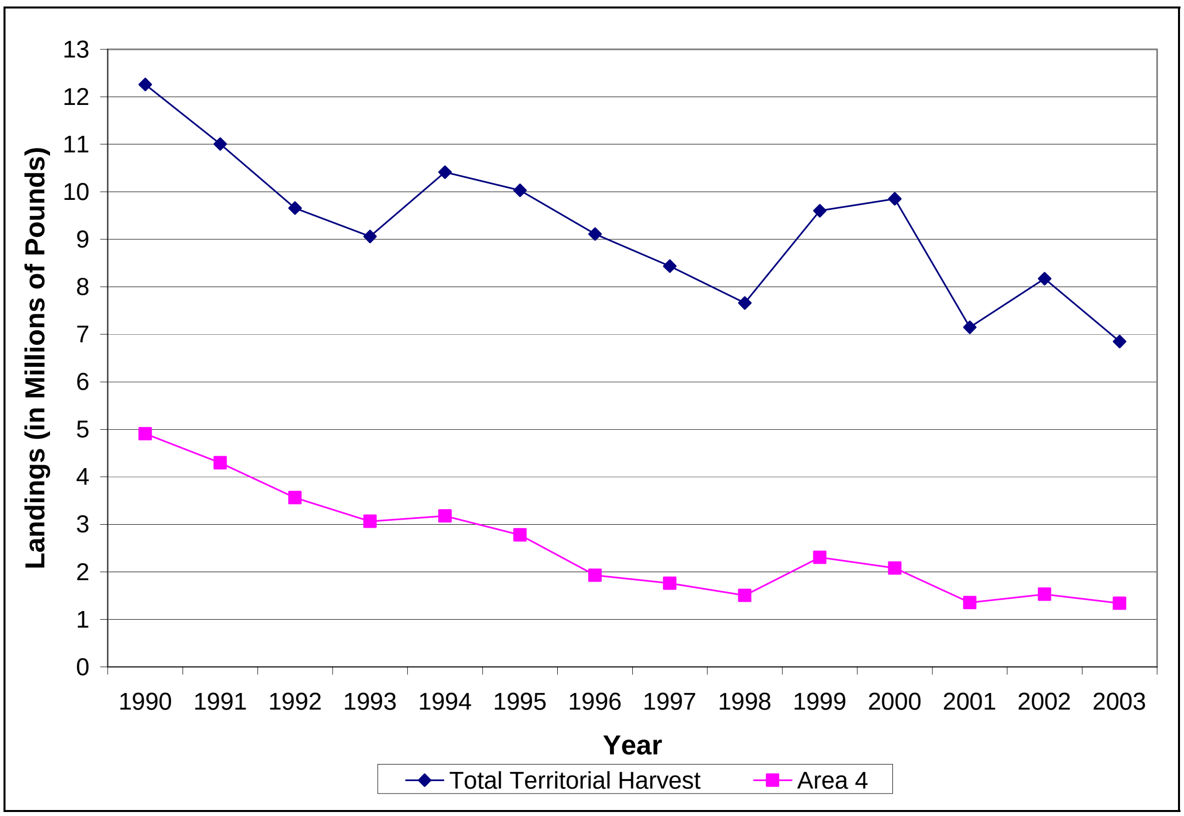
[4] Total territorial harvest includes all poundage of lobster landed by both coastal commercial license holders and seasonal commercial license holders. See description of lobster permit types above.



Source: Dean *et al.*, 2005.
Note: Coastal regions are outlined in red.

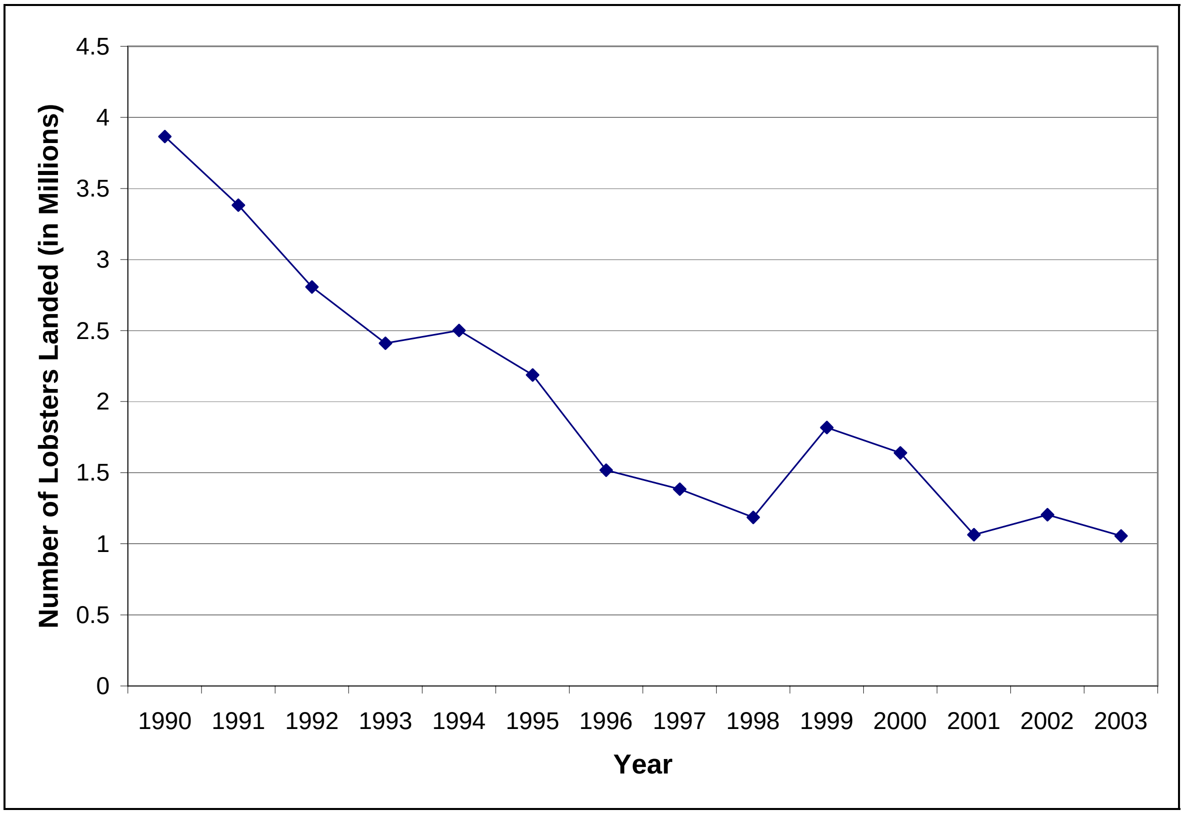
Figure 3-19. Statistical Reporting Areas in Massachusetts

Based on landing data collected by the State, the annual lobster catch in Massachusetts and Area 4 (including Boston Harbor), as well as total landings has declined over the last 20 years. Although landings have remained fairly steady from 2001 through 2003 (Figure 3-20). As of 2003, the territorial catch is about one-half that of a decade ago and Boston Harbor area one-fourth that of 1990, most likely due to a decrease in the resource. There were approximately 1,000,000 marketable-sized lobsters landed in Area 4 in 2003, and around 1,200,000 lobsters in 2002 (Figure 3-21). Although the decline in landings (both poundage and numbers) within Area 4 began in 1990 when nearly 5 million lobsters were landed, landings since 1996 have been substantially lower than pre-1996 levels, and the number of lobsters landed has fluctuated between 1.8 and 1.0 million lobsters (Figure 3-21). Current landings in Area 4 are approximately one-quarter of their 1990 levels. The State overall has shown a declining trend in landings from 1990 to 2003, but with the total territorial harvest declining from 12,260,805 lbs to 6,850,185 lbs, which is by nearly half, the decline has been substantially less than area 4 (Figure 3-19).



Source: Area 4 data from Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA. Additional data compiled from Dean *et al.*, 2005; 2004; 2002; McBride *et al.*, 2001; McBride and Hoopes, 2000; Pava *et al.*, 1999; 1998; 1997; 1996; McCarron and Hoopes, 1995; 1994, 1993, 1992; Hoopes, 1991.
Note: Data not yet available for 2004.

Figure 3-20. Annual Landings (in Millions of Pounds) for State Territorial Waters and State-Managed Area 4

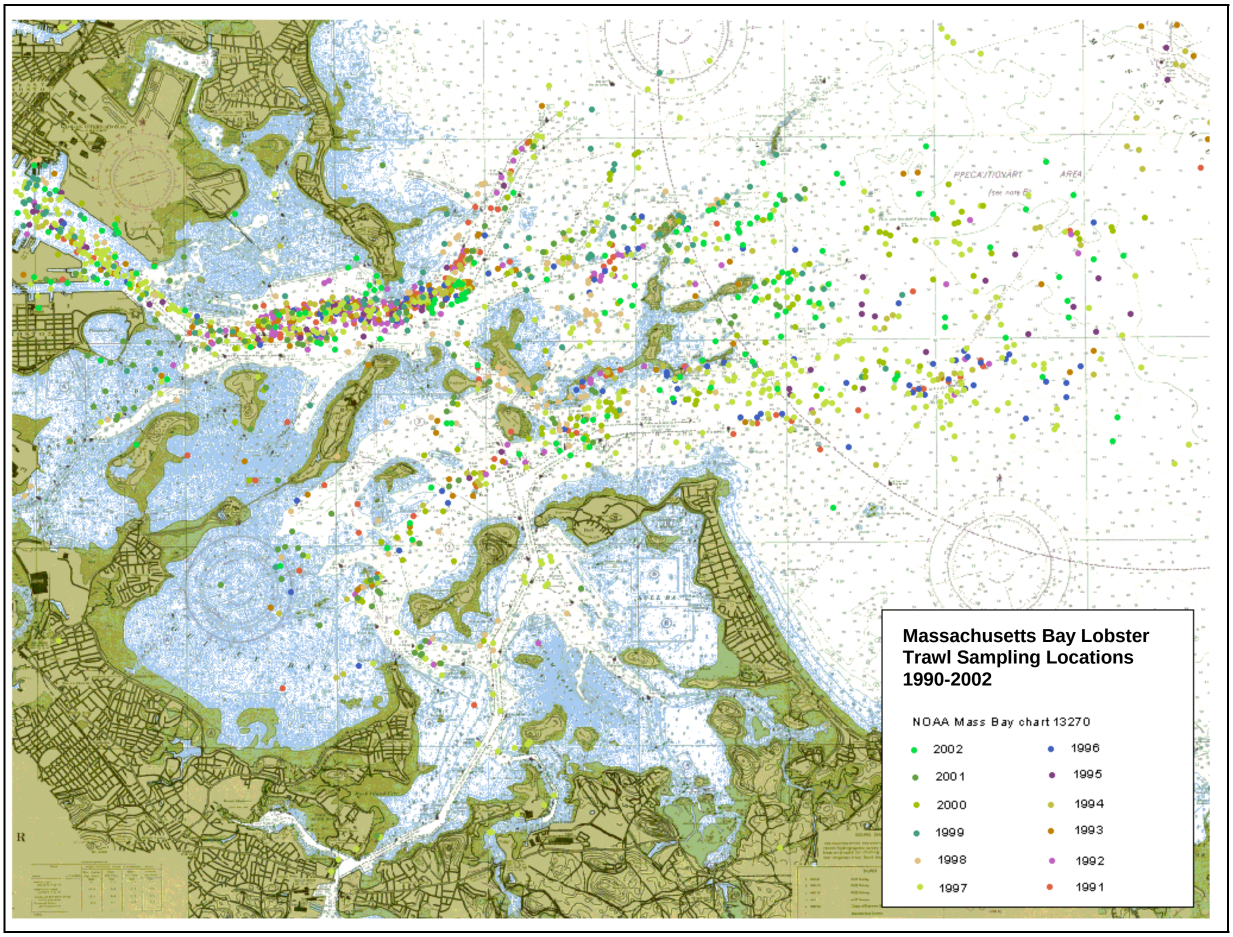


Source: Area 4 data from Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA. Additional data compiled from Dean *et al.*, 2005; 2004; 2002; McBride *et al.*, 2001; McBride and Hoopes, 2000; Pava *et al.*, 1999; 1998; 1997; 1996; McCarron and Hoopes, 1995; 1994, 1993, 1992; Hoopes, 1991.
Note: Data not yet available for 2004.

Figure 3-21. Annual Number of Lobsters Landed (in Millions) in State-Managed Area 4

The MA DMF conducts annual sampling aboard commercial vessels to assess various biological parameters of legal, sub-legal (i.e., undersized), and ovigerous (i.e., egg-bearing) lobsters in several of their management areas, including Area 4 (Figure 3-22). This sampling program has been ongoing since 1981 for stock assessment purposes (Estrella and Glenn, 2001; 2002). Sampling occurs monthly in coastal waters during May through November aboard only a few commercial vessels conducting normal fishing operations in a designated region. Traps are not necessarily hauled in the same locations as in prior months within a year or among different years. Thus, there is no standardized sampling protocol, other than to simply sample wherever participating fishers happen to be fishing at the time of the sample. Although it might be expected that the lobstermen would place pots where the most lobsters would occur. While normal fishing traps are used in this program, the trap types and vent styles may vary among participating fishers. As a result, the data are highly dependent on the individual characteristics of the fishers[5] involved in the sampling, as well as on the type of trap used. In addition, statistical robustness of the data is achieved only when the data are pooled and analyzed by area (e.g., Boston Harbor), because many locations within an area have been sampled only once during the more than 20 years of sampling (Robert Glenn, personal communication, June 2005).

[5] The number of fishers participating year-to-year in the Boston Harbor project area is typically small—about 2 to 3 individuals (Bob Glenn, MA DMF, personal communication).



Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.
Note: Sampling locations are not available for years 1984-1990, as their coordinates were not recorded until 1991.

Figure 3-22. MA DMF Boston Harbor and Massachusetts Bay Sea Sampling Locations for the Years 1991-2002

MA DMF sea samplers onboard commercial vessels record trap location coordinates, carapace length (CL), sex, condition, the presence or absence of eggs on females, number of lobsters caught, number of trap hauls, and set-over days[6]. By statute, undersized lobsters cannot be landed and often escape from traps via vents prior to haul, or are returned to the ocean when captured. Likewise, legal-sized ovigerous females cannot be landed and must be returned immediately to the ocean when captured. Adult, marketable lobster catch rates are expressed as catch-per-trap-haul standardized to a three day set-over-day (Estrella and McKiernan, 1985). Undersized lobsters (sub-legals) or ovigerous females are not standardized to three day set-over days, but are standardized to the same number of set-over-days (i.e., if one set of hauls occurred after eight set-over-days, one occurred after twelve set-over-days, and another occurred after four set-over-days, all would be standardized to four set-over-days).

The overall catch-per-trap-haul in the Boston Harbor area (inclusive of all sampling locations in Boston Harbor) has been slowly decreasing from slightly more than one legal-sized lobster per trap for three set-over-days to between 0.4 and 0.8 legal-sized lobster per trap (Figure 3-23). A similar trend is seen for sub-legal lobsters (Figure 3-23); however, the larger variability of the sub-legal data likely relates to changes in the escape vent (both in terms of size and shape),

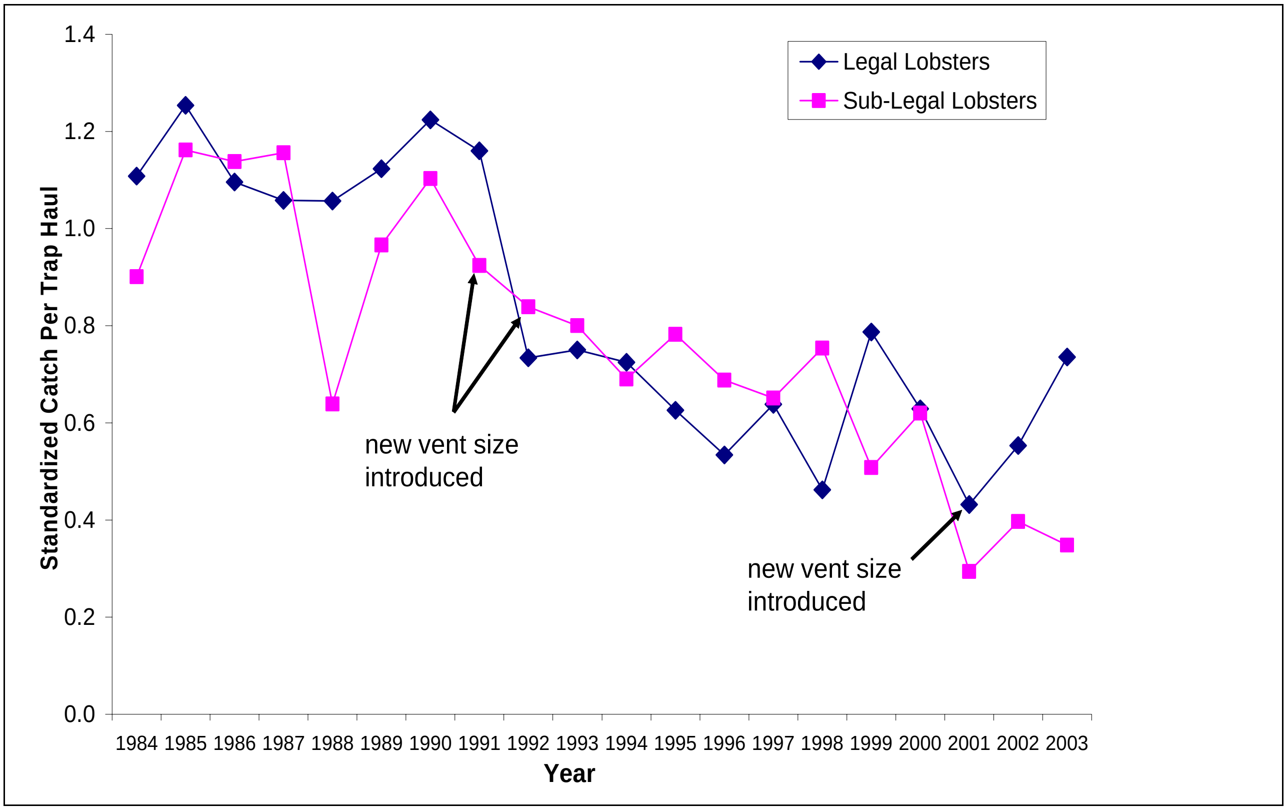
[6] Set-over days refers to how many days the trap has been "set" in the water prior to being hauled.

which affects the number of sub-legal lobsters capable of escaping from the traps. The size of escape vents has changed three times in the last decade (1991, 1992, and 2001), increasing by a total of $^{3}/_{16}$", and currently stands at a size of $1^{15}/_{16}$". During the same time period, the size limit of marketable lobsters increased from 81 mm CL in 1989 to 83 mm CL in 1991. It is thought that by increasing the size of the escape vent, juveniles that might enter the trap to feed will be able to leave, so as to not result in saturation of the trap by undersized individuals that cannot be legally landed. Thus, increases in the vent size should, theoretically, increase the likelihood of capturing marketable-sized lobsters.

Commercial landings (as well as sea sampling landings) from State territorial waters follow a seasonal trend, with the lowest landings in February (Figure 3-24). A steady increase occurs during the spring and summer months, with a peak occurring in September/October, followed by a steady decline through the winter months to February (Dean, *et al.*, 2005; 2004; 2002; McBride, *et al.*, 2001; McBride and Hoopes, 2000). This trend reflects the lobster's dependence on temperature for movements and feeding, both of which affect entrapment (Ennis, 1973; Miller, 1990; Cobb, 1995; Tremblay, 2000). Temperature affects the activity rate of lobsters, specifically their walking rate; below 10ºC, the walking rate is severely reduced (McLeese and Wilder, 1958), and lobsters are less likely to leave their shelters or depressions (Stewart, 1972), and therefore, are unlikely to enter a trap. Similarly, their molt condition affects entrapment, with the lowest catches corresponding to the timing of ecdysis[7] or molting (Miller, 1990). The timing of ecdysis for adults and adolescent lobsters depends on the thermal regime in which they live. In areas with relatively high summer temperatures, there are usually two molting peaks, one in the spring and one in the autumn. In colder areas, or areas that experience less dramatic summer temperatures, ecdysis tends to occur in late summer (Templeman, 1936). In Boston Harbor, molting tends to occur in late summer (Bernie Feeney, personal communication, June 2005).

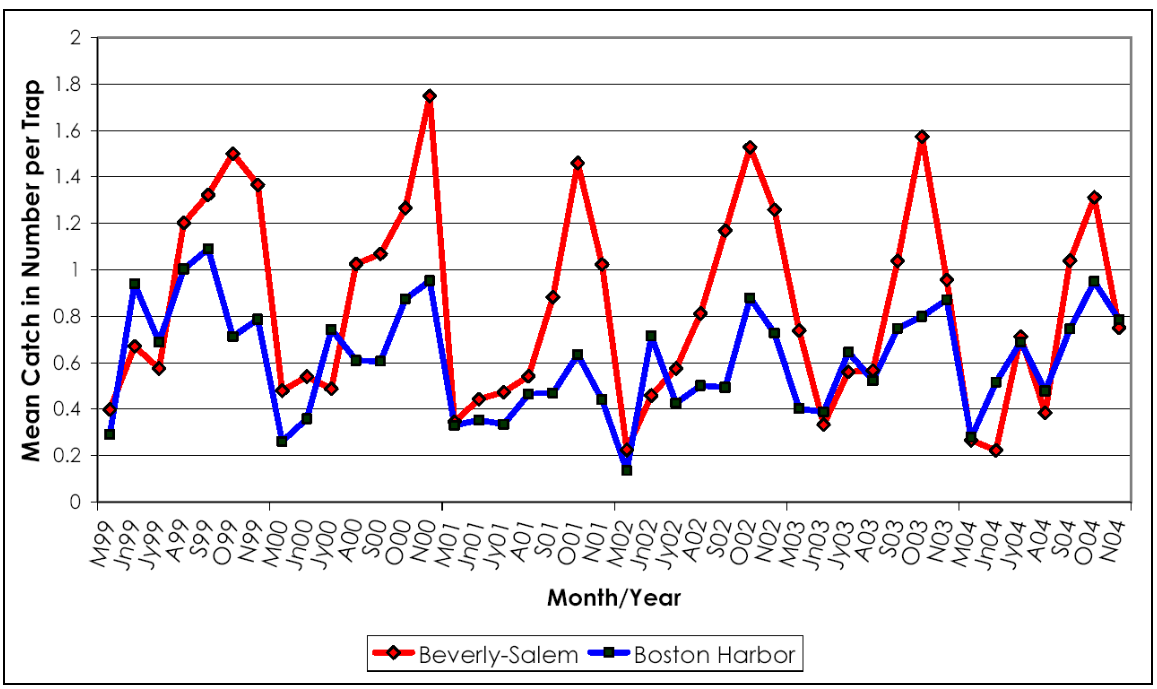
Ovigerous (Egg-Bearing) Females - While the overall catch-per-trap-haul has been decreasing in Boston Harbor, the percentage of ovigerous females per trap haul has been steadily increasing (Figure 3-25) from less than 2% in 1984 to approximately 12% in 2003. It is unknown whether these ovigerous females reside in the shallow coastal waters of the harbor throughout the year or migrate to deeper waters in the late fall/early winter months to subject their eggs to a more constant thermal regime. Large, sexually mature females have been described as employing several different strategies: 1) moving from deep to shallow waters to subject developing embryos to thermal regimes for optimal development ("seasonal migrators"); 2) moving long distances ("migrators"); or 3) remaining in a particular home location ("groundskeepers") (Pezzack and Duggan, 1986).

[7] Ecdysis refers to the shedding of and escape from the old exoskeleton (shell). Recently molted lobsters are called "new shells" or "paper shells" to represent the thin, non-calcified exoskeleton immediately post-molt.



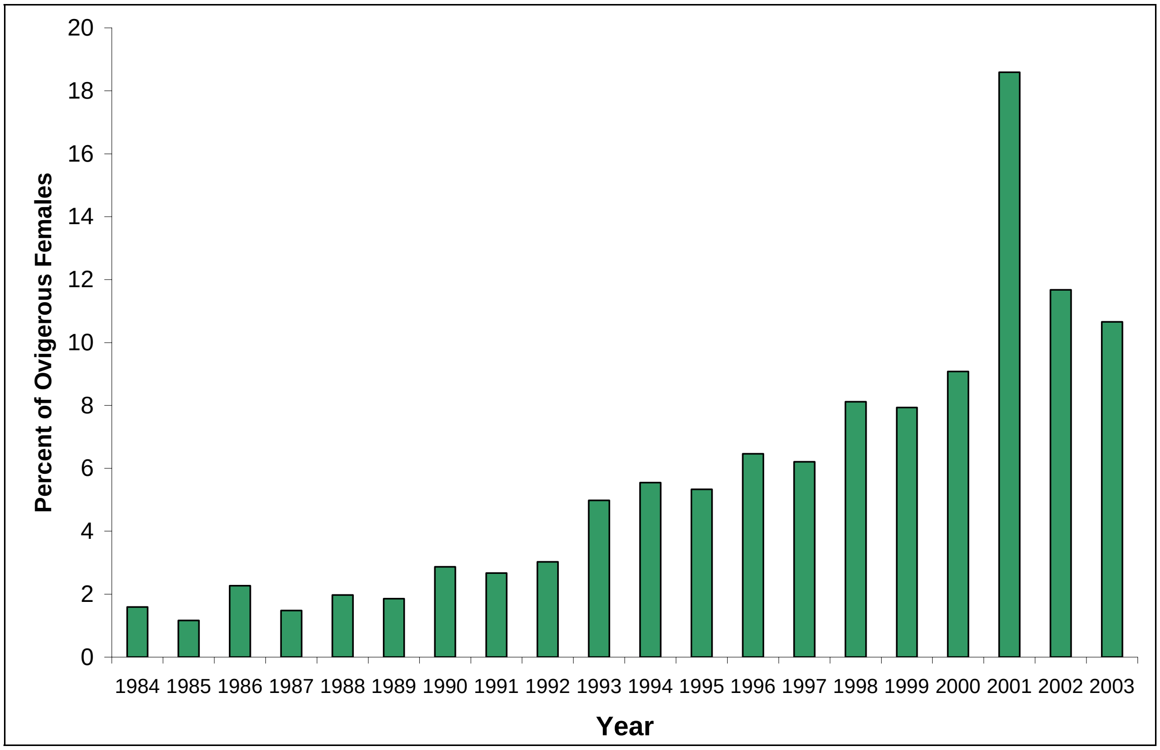
Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.
Note: Data are standardized to three set-over-days.

Figure 3-23. Catch-per-trap-haul in Boston Harbor from the MA DMF Sea Sampling Program for Marketable (Legal) Lobsters and Non-marketable (Sub-legal) Lobsters



Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.
Note: Data are standardized to three set-over-days.

Figure 3-24. May-November Sea Sampling Catch-per-trap-haul for Beverly-Salem and Boston Harbor for the Years 1999-2004



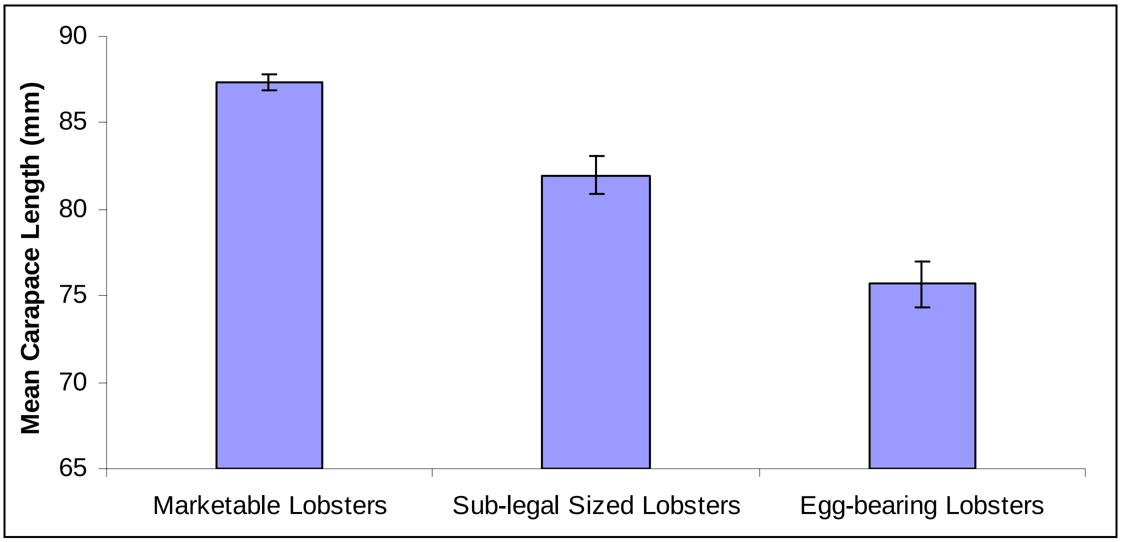
Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.

Figure 3-25. Percent of Ovigerous Females in MA DMF Sea Sampling Program for Area 4

Historically, lobster researchers assumed that small, inshore ovigerous females moved into deeper waters to avoid subjecting their developing larvae to rapidly changing or more extreme water temperatures during the late fall/early winter and early spring/summer months (Lawton and Lavalli, 1995). In contrast, most large, sexually mature females were groundskeepers that did not undertake seasonal migrations (Campbell, 1986). More recently, however, others (Krouse, 1980; Cooper and Uzmann, 1980; Haakonsen and Anoruo, 1994; Lawton and Lavalli, 1995) have noted that inshore lobsters (both male and female) tend to restrict their movements locally, such that while they may change their home ranges ("street") every couple of days, they tend to remain in the same "neighborhood" (Watson, 2005).

As previously mentioned, lobster movements are strongly influenced by temperature; however, it is unclear how females specifically react to changing temperatures. New, multi-seasonal data from a two-year study following sonar-tagged ovigerous females in Maine (Cowan, *et al.*, 2005), suggests that differently sized ovigerous females employ different movement strategies. Small brooders (< 93 mm CL) reside within coastal waters throughout their egg-bearing months, experiencing cold water temperatures from November through April and warm temperatures from mid-May through July. Large brooders (> 93 mm CL) travel greater distances and experience more moderate temperatures throughout the year, even if they brood and hatch their eggs near their spawning grounds. Both small and large brooders tend to hatch their eggs around the same time in the summer (Diane Cowan, personal communication, March 2005); thus, changes in thermal regimes do not necessarily exert major effects on developing embryos.

The average carapace length of ovigerous females sampled in the MA DMF sea sampling program in Boston Harbor ranges between 72 and 78 mm CL (Figure 3-26), making them "small brooders[8].” These female lobsters are typically smaller in size than either sub-legal or legal lobsters, which reflect the fishing pressure put on the resource that selects for early maturation of females. These females, therefore, are likely to remain in Boston Harbor, spawning early, and brooding and hatching their eggs annually within the harbor. Thus, they likely provide a local recruitment source of benthic juveniles. Evidence of this is, to some extent, provided by the presence of early benthic phase lobsters (Stage IV to yearlings, ~5 to 15 mm CL) found in a number of locations in the Boston Harbor region, which are likely supplied, in part, by these resident females. If the females remain resident in the area throughout the year, they are likely to remain within their shelters and move very little during the winter months. Any physical disruption of their habitat in winter months could severely impact them and their brooding embryos because of their reduced ability to move quickly during cold temperatures.



Source: Robert Glenn, Coastal Lobster Investigations Project, MA DMF, Pocasset, MA.
Note: Error bars represent ± one standard deviation

Figure 3-26. Mean Carapace Length of Legal-sized (Marketable), Sub-legal sized, and Ovigerous (Egg-bearing) Females Represented in the MA DMF Sea Sampling Program for Area 4 from 1984 to 2003

Region 4 was further subdivided into four subregions A, B, C, and D (see Figure 3-27) to show any potential variance in the project area from the remaining subregions. No trend was apparent in the marketable size of lobsters for any of the subregions. As mentioned above, the overall trend in the number of lobsters (including the ovigerous females and sublegal sized lobsters) caught is declining. It appears that the catch of ovigerous lobsters is greater in subregion B than in the other subregions, suggesting that this area may have a higher proportion of ovigerous female lobsters. Also, it appears that the catch of sublegal lobsters is greater in the outer subregions, suggesting that these areas may have a higher proportion of sublegal lobsters. However, it is important to note that only a small fraction of lobsters present in an area will actually be collected in traps, and to determine the actual abundance of ovigerous females or sublegal lobster would require a different type of experimental design and more sophisticated statistical analysis (see Figure 3-28 and Figure 3-29).

[8] They are considered “small brooders” because their average carapace length is less than that previously determined for the size at 50% sexual maturity (~86 mm CL) in Boston Harbor (Estrella and McKiernan, 1985; Glenn and Pugh, 2005).

Summary - Lobsters captured from Massachusetts State waters have been showing a significant decline in numbers for the past decade. The decline in the number lobsters in the Boston Harbor area have shown a more severe decline than that of the reminder of the State. Despite this, lobsters continue to be an important fishery in the State, and as such, are being carefully studied and managed. Recent studies have focused on lobster larval development and movement within Massachusetts Bay. Populations of EBP lobsters less than 12 mm CL are known to exist in high densities outside of the navigation channel and along island coastlines. Here, they utilize cracks within the bedrock, boulders/cobble, and rocks within glacial drift for their shelter-providing habitat. The depth of the navigation channel and the substrate in the Inner Harbor and Mystic and Chelsea Rivers likely restrict habitat exploitation by EBPs, which prefer shallower, non-depositional habitats outside of the footprint. Other size classes of lobsters, such as larger juveniles (>12 mm CL), sub-legal sized lobsters (> 30 mm CL), and adults capable of utilizing all of the described habitats in the navigation channel (see Figure 3-1), as shown in the ventless trap study by MA DMF, are found in all of these environments in Boston Harbor. Within the planned dredge footprint for the navigation channel, both non-depositional and depositional environments exist; therefore, lobsters of these larger class sizes are likely to exploit the habitats in the same manner as they are exploiting the habitats outside of the planned dredge footprint.

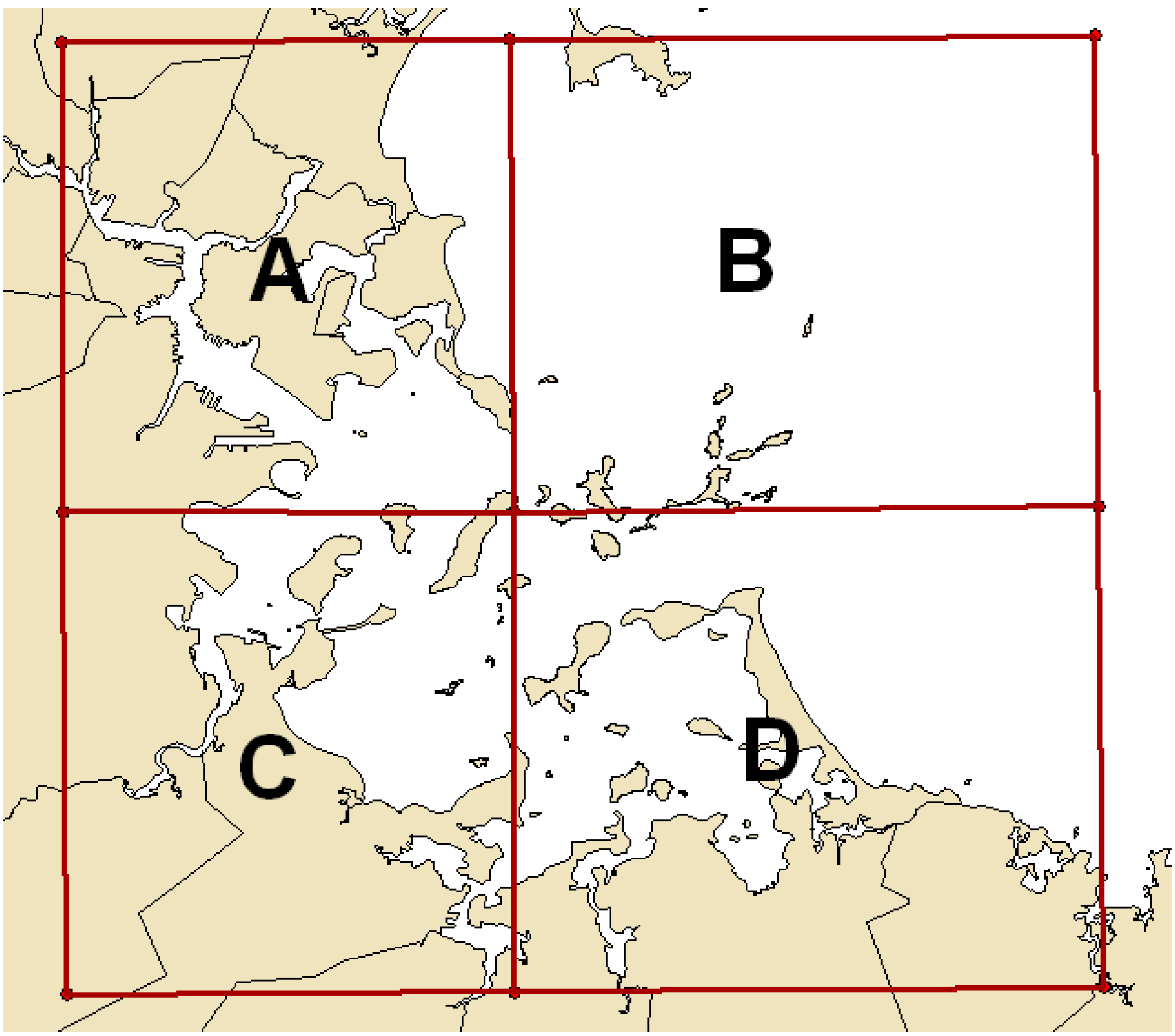


Figure 3-27. Location of Subregions A, B, C, and D in Area 4

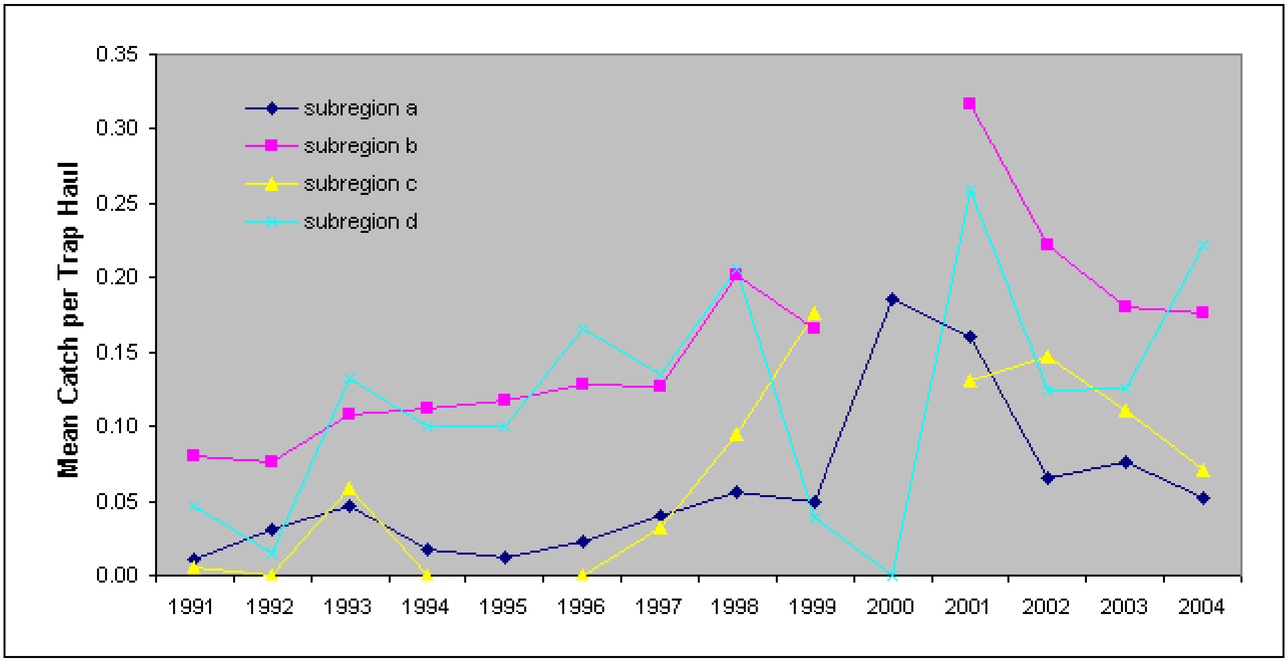


Figure 3-28. Mean Catch-per-Trap Haul for Ovigerous Females from Subregions A, B, C, and D in Area 4

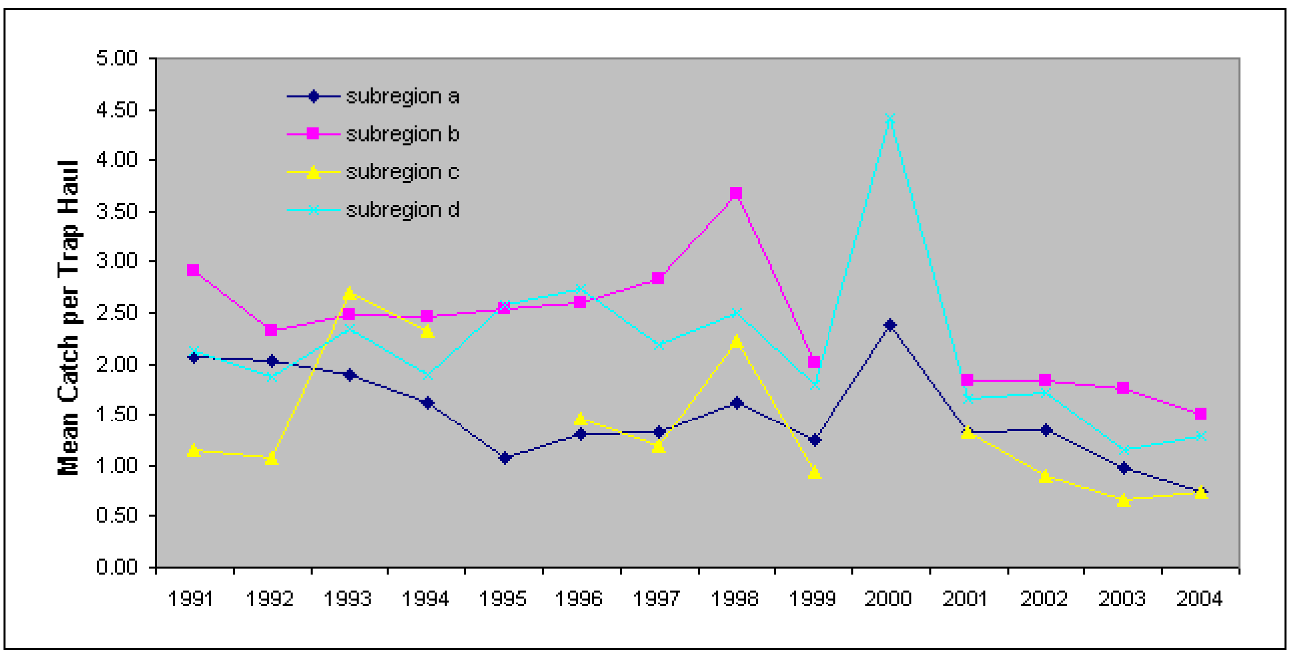


Figure 3-29. Mean Catch-per-Trap Haul for Sublegal Sized Lobsters from Subregions A, B, C, and D in Area 4

Marine and Coastal Birds

Many different types of resident, migratory, and coastal birds may potentially use the areas of Boston Harbor and Massachusetts Bay as feeding, nesting or resting areas. The diversity of birds nesting in Boston Harbor is high (Paton *et al*., 2005). Besides the many species that nest on islands throughout the Harbor, there are a broad array of migrants that use the area during spring and fall migration. In general, shallow open water areas may provide feeding habitat for many wading birds. The deeper open water areas may provide feeding habitat for several species of waterfowl and waterbirds such as cormorants, grebes, and loons.

For over 100 years, the Audubon Society Christmas Bird Counts (National Audubon Society, 2005) have identified the recorded many species along the Massachusetts coastline and from Stellwagen Bank. Appendix B lists the coastal and marine birds that have been recorded in the Boston Harbor and Massachusetts Bay areas from these surveys as well as other local surveys. These birds are classified by their marine habitat as pelagic, shorebirds, waterfowl, colonial water birds, raptors, and marsh birds.

Marine Mammals and Reptiles

All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act of 1972 (MMPA), most recently reauthorized in 1994. The MMPA established a moratorium, with certain exceptions, on the taking of marine mammals in U.S. waters and on the taking of marine animals by U.S. citizens on the high seas. The term "take" is statutorily defined to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal." The moratorium also prohibits the importation of marine mammals and marine mammal products into the United States. NOAA Fisheries (NMFS) has responsibilities under MMPA that include monitoring populations of marine mammals to ensure that they stay at optimum levels. If a population falls below its optimum level, it can be designated as "depleted," and a conservation plan is developed to guide research and management actions to restore the population to healthy levels.

Only transient marine mammals and reptiles (sea turtles) are found in the Boston Harbor area. The likelihood of finding one of these species increases in Massachusetts Bay. Most marine mammals and reptiles that may be possible visitors to Boston Harbor and Massachusetts Bay areas are listed as Federally threatened or endangered and are discussed in the section below. Marine mammal species that may travel within the project areas and are not discussed in another section include the harbor seal, white-sided dolphin, harbor porpoise, gray seal, and minke whale.

Harbor Seal (*Phoca vitulina concolor*) - The harbor seal, also known as the common seal, is found throughout coastal waters of the Atlantic Ocean from Canada to southern New England, New York, and adjoining seas (Waring *et al*., 2004) above 30° N latitude. Harbor seals spend the late spring, summer, and early fall between New Hampshire and the Arctic, where they breed and care for newly born pups. A general southward movement from the Bay of Fundy to southern New England waters occurs in fall and early winter, mostly consisting of juveniles and subadults. Whitman and Payne (1990) have suggested that this age-related dispersal may reflect the higher energy requirements of younger individuals. After overwintering in southern New

England and New York coastal waters, the vast majority of the population migrates to the northern waters of New Hampshire, Maine, and Canada in the spring for the pupping season (mid-May through June). No pupping areas have been identified in the project areas.

The harbor seal is not listed as threatened or endangered under the Endangered Species Act (ESA), and it is not considered a strategic stock (i.e., a stock whose mortality is at a level that will destroy the population) by NMFS.

White-sided Dolphin (*Lagenorhynchus acutus*) - The white-sided dolphin occurs in temperate and polar waters in the North Atlantic Ocean, typically over the continental shelf to the 330-foot depth contour. White-sided dolphins are potential, but rare visitors to the outer project areas in Massachusetts Bay. The white-sided dolphin is not listed as threatened or endangered under the ESA and is not considered a strategic stock by NMFS. The habitat range of the white-sided dolphin is generally in deeper waters of the continental shelf and therefore would rarely be found in the inner Boston Harbor, but have been sighted around the Boston Harbor Islands.

Harbor Porpoise (*Phocoena phocoena*) - The harbor porpoise is primarily an inshore species. During the summer, harbor porpoises are concentrated in the northern Gulf of Maine and the southern Bay of Fundy region, generally in waters less than 490 feet deep. This stock of harbor porpoises migrates south into the mid-Atlantic region during the fall and spring months; they are widely distributed from New Jersey to Maine. Low densities of harbor porpoises are found in waters off New York and north to Canada in the winter. No specific migratory routes to the Gulf of Maine/Bay of Fundy region have been identified. The best estimate for the abundance of the Gulf of Maine/Bay of Fundy population is 89,700 animals, with a minimum population estimate of 74,695 (Waring *et al*., 2004).

During the period of 1994 to 2001, 831 harbor porpoise strandings were reported from Maine to North Carolina, with only 27 strandings in 2000. Massachusetts alone had 219 strandings during this period. No specific information on locations in Massachusetts was available. NMFS considers the Gulf of Maine/Bay of Fundy harbor porpoise stock as a strategic stock, though the stock has preliminarily been removed from the ESA candidate species list by the NMFS (Waring *et al*., 2004). The preferred nearshore habitat of the harbor porpoise makes it a potential species to be found in the Boston Harbor area, it has been recorded as far into the harbor area as Chelsea Creek.

Gray Seal (*Halichoerus grypus*) - The gray seal is found on both sides of the North Atlantic. The western North Atlantic population occurs from New England to Labrador (Waring *et al*., 2004). Gray seals inhabit temperate and sub-arctic waters and are found from Maine to Long Island Sound in the United States. There are two breeding concentrations in eastern Canada, one at Sable Island and a second that breeds on the pack ice in the Gulf of St. Lawrence. A small number of animals and pupping have been observed on several isolated islands along the Maine coast and in Nantucket-Vineyard Sound, Massachusetts.

Gray seals are the second most common pinniped along the Atlantic coast of the US, living on remote, exposed islands, shoals, and unstable sandbars. Pupping occurs from late December through mid-February. There are no regular seasonal migrations, but young individuals wander extensively during their first two years of life. Gray seals feed on a wide variety of fish (Lesage and Hammil, 2001) as well as squid, octopus, crustaceans and even a seabird or two. The majority of dives are to depths of 230 to 328 feet, but gray seals can dive to depths greater than 1,312 feet.

Minke Whale (*Balaenoptera acutorostrata*) - Minke whales occur throughout polar, temperate, and tropical waters. The minke whale is the third most abundant great whale in the Atlantic Ocean within 200 nmi of the U.S. coastline (Winn, 1982). Minke whales off the east coast of the Unites States are part of the Canadian east coast population, one of four minke populations recognized in the North Atlantic. The range of this population extends south from Canada to the Gulf of Mexico, but distribution is primarily concentrated in New England waters, with most sightings occurring in the spring and summer months. Based on surveys conducted in 1995 and 1999, the best available current abundance estimate for minke whales in the western North Atlantic is 4,018 animals, with a minimum estimate of 3,515 animals (Waring *et al*., 2004). This species is found in open seas primarily over continental shelf waters, but it occasionally enters bays, inlets, and estuaries. Minke whales may occasionally visit Boston Harbor and Massachusetts Bay, as is made evident by a recent minke whale mortality report. In 2001, a minke whale was found dead in Massachusetts Bay (42º 21'N 70º 43'W) with fairly fresh entanglement marks on the tail stock and across the tail flukes (Waring *et al*., 2004)

The minke whale is not listed as threatened or endangered under the ESA, as depleted under the MMPA, or as a strategic stock by NMFS.

Information on other marine mammals and sea turtles that are listed on the Federal threatened and endangered species list and that may be possible visitors to Boston Harbor and Massachusetts Bay areas can be found in the following section.

Threatened and Endangered Species and Species of Special Concern

The Endangered Species Act (ESA) provides for the conservation of species that are endangered or threatened with extinction throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. Endangered species are species that are in danger of extinction throughout all or part of their range, or that are in danger of extirpation. Threatened species are native species that are likely to become endangered in the foreseeable future, or that are declining or rare (NOAA Fisheries, n.d.). State governments are also concerned with species of special concern, which are native species that have experienced a decline which, if continued unchecked, could threaten the species, or that are so restricted in abundance, distribution, or specialized habitat requirements that they could easily become threatened. Any native species listed as endangered or threatened by the U.S. Fish and Wildlife Service is also included on the Massachusetts State list as threatened or endangered (MA NHESP, 2004).

Section 7 of the Endangered Species Act of 1973 (ESA, P.L. 93-205) requires that all Federal agencies ensure that any action they authorize, fund, or carry out will not jeopardize the continued existence of any Federally endangered or threatened species or result in the destruction or adverse modification of any critical habitat of such species. The Corps is mandated by Section 7 of the ESA to consult with the Department of Commerce (NOAA Fisheries) and the Secretary of Interior (U.S. Fish and Wildlife Service [USFWS]) to determine if any Federally protected species may be affected by a project. This consultation may include preparation of a

Biological Assessment to determine if the proposed action is likely to result in adverse effects to threatened or endangered species. The Corps initiated consultations with NOAA Fisheries and USFWS to determine the presence of any Federally Protected species that may coincide with the proposed project.

In response to the consultations with NMFS, the Corps was notified of the following nine Federally endangered or threatened marine mammals and reptiles (therefore, all nine species are also considered to be endangered or threatened by the State of Massachusetts). While it is possible that any of these species may be found in the project area, it is an unlikely event, especially within the dredge site.

The Federally endangered North Atlantic right whales *Eubalaena glacialis*, humpback whales *Megaptera novaeangliae*, fin whales *Balaenoptera physalus*, sei whales *Balaenoptera borealis*, and sperm whales *Physter macrocephalus* may all be found seasonally in Massachusetts' waters. North Atlantic right whales have been documented in the nearshore waters of this region including Massachusetts Bay from January through September. Humpback whales feed during the spring, summer, and fall over a range that encompasses the eastern coast of the United States. Fin, sei and sperm whales are common in deeper offshore waters. While these whale species are not considered residents of Boston Harbor or Massachusetts Bay, it is possible that transients may enter the area during seasonal migrations.

The sea turtles in northeastern nearshore waters are typically small juveniles with the most abundant being the Federally threatened loggerhead *Caretta caretta* followed by the Federally endangered Kemp's ridley *Lepidochelys kempi*. Federally endangered leatherback sea turtles *Dermochelys coriacea* are located in New England waters during the warmer months as well. While leatherback are predominantly pelagic, they may occur close to shore, especially when pursuing their preferred jellyfish prey. The Federally threatened Green sea turtles *Chelonia mydas* may also occur sporadically in Massachusetts' waters, but those instances would be rare.

Humpback Whale (*Megaptera novaeangliae*) - Humpback whales occur in all oceans of the world, except possibly the Arctic (NMFS, 1991). Until the early 20th century, humpback whales were an important commercial species throughout most of their range, including New England waters (Allen, 1916), and some taking of the species occurred in northwest Atlantic waters until the mid-1950s. The International Convention for the Regulation of Whaling (adopted in 1946) afforded the North Atlantic population of humpback whales full protection in 1955 (Best, 1993). Humpback whales were afforded endangered species status in the United States in 1970 (USFWS, 1986). The best abundance estimate currently available for humpbacks in the Gulf of Maine is 902 whales, with a minimum population estimate of 647 individuals (Waring *et al*., 2004).

The humpback whale is a migratory species that spends the summer in highly productive northern latitude feeding grounds (40° to 75° N latitude) (NMFS, 1991). Humpback whales regularly visit the waters of southern New England, including the deeper, continental shelf areas of Massachusetts, where they are present in greatest abundance between June and September. All age classes, including mother/calf pairs, are present during the summer. Humpback whales spend most of their time in New England waters concentrated in areas where their preferred foods are most abundant. One of the primary feeding grounds is Stellwagen Bank, located off the coast of Massachusetts at the mouth of Massachusetts Bay. Humpback whales are the top carnivores in a relatively simple food chain consisting of phytoplankton, zooplankton, small forage fish (sand lance), and crustaceans. During their seasonal northern residency in the area, they may also feed on several commercially important fish and invertebrates, such as herring (*Clupea harengus*), mackerel (*Scomber scombrus*), menhaden (*Brevoortia tyrannus),* pollock (*Pollachius virens*), small haddock (*Melanogrannus aeglfinus*), and squid (*Illex ilecebrosus*) (Overholtz and Nicolas 1979; Whitehead and Class 1985; Whitehead 1987; Piatt *et al*. 1989; NMFS 1991).

There may be seasonal movement (May to October) of humpback whales in the vicinity of MBDS.

Fin Whale (*Balaenoptera physalus*) - Fin whales are present in all major oceans of the world, from the Arctic to the tropics, with greatest numbers in temperate and boreal latitudes (Evans, 1987). Fin whales were identified as endangered throughout their range in 1970 by the Federal government. Because of their high cruising speed, fin whales were not harvested commercially in large numbers until other species, such as slow-moving right whales, were depleted and whalers developed high speed boats (Leatherwood *et al*., 1976). A fishery for this species existed in Nova Scotia from 1964 to 1972 (Mitchell, 1974), and commercial harvesting of fin whales elsewhere in the world continued at least into the early 1990s. For the western North Atlantic fin whale population, the best estimate of abundance is 2,814, with a minimum population estimate of 2,362 (Waring *et al*., 2004). Due to the fin whale's extended distribution and poorly understood population structure, this is considered to be an extremely conservative estimate.

Fin whales are commonly seen on the continental shelf in waters less than 328 feet deep. New England waters are important summer feeding grounds for fin whales, and the species is most abundant off of the Massachusetts coast along the 130 to 165-foot depth contour, particularly in the Great South Channel east of Cape Cod, across Stellwagen Bank, and northeastward to Jeffrey's Ledge (north of Cape Ann, Massachusetts) (Hain *et al*., 1992). During the fall and winter, the majority of these whales migrate south to wintering grounds offshore of the Delmarva Peninsula and the Outer Banks of North Carolina (Winn, 1982). Others concentrate at the mid-shelf region east of New Jersey as well as areas on Stellwagen Bank and Georges Bank. Year after year, juveniles will return to the same feeding areas they first visited with their mothers (Seipt *et al*., 1990; Clapham and Seipt, 1991). The fin whales' preferred feeding grounds in the coastal areas (130 to 165-foot depth contour) indicate that these whales may be found in the area of the MBDS.

Northern Right Whale (*Eubalaena glacialis*) - The northern right whale was a prime target of early whale fisheries along the coast of the eastern United States from the 1600s through the early 1900s, due to its coastal distribution, slow swimming speed, high oil yield, and characteristic of floating when dead (Brown, 1986; Aguilar, 1987). Due to intense exploitation, it is now the rarest of the large whales and is in danger of extinction. The northern right whale was classified as endangered in 1970 (35 FR 8495) by the Federal government. Three areas have been designated as critical habitat for the northern right whale: the Great South Channel, Cape Cod Bay, and southeastern U.S. waters 13 nmi offshore from the Alameda River, Georgia to Sebastian Inlet, Florida. The western North Atlantic population will be considered "recovered" when it reaches 60 to 80 percent of its pre-exploitation number (NMFS, 1991), or about 7,000 animals. The 1998 population estimate was 291 individuals (Kraus *et al*., 2001). Despite the cessation of whaling and the implementation of the MMPA (1972) and the ESA (1973), the population of northern right whales appears to be growing at a very slow rate.

Generally, right whales are found along the east coast of North America (Winn, 1982). Some female right whales have been observed to migrate more than 1,600 nmi from their northern feeding grounds to the southern calving/wintering grounds (Knowlton *et al*., 1992). Right whales can be expected to visit Massachusetts Bay and Cape Cod Bay throughout the year (Brown *et al*., 2002), but Cape Cod Bay is a primary feeding ground and nursery used from late winter until early spring. Most whales are found in areas where their primary food sources, including copepods and juvenile euphasiids, can be easily located.

The most significant human impacts to right whales are collisions with vessels and entanglement in fishing gear. Habitat change is believed to be another cause of decline in right whale populations. Anthropogenic sources of change include pollution, oil and gas exploration, seabed mining, wastewater discharges, dredged material disposal, and a general increase in coastal activities due to an increase in human population along the U.S. east coast (NMFS, 1991; Steinback *et al*., 1999).

Sei Whale (*Balaenoptera borealis*) - The sei whale breeds and feeds in open oceans and is generally restricted to more temperate waters, although it can be found in the North Atlantic Ocean from Iceland south to Venezuela. These whales are generally found in deeper waters characteristic of the continental shelf edge region (Hain *et al*., 1985). During feeding season, the sei whale population is generally centered in northerly waters with occasional trips into more shallow and inshore waters. The sei whale, like the right whale, is largely planktivorous, feeding primarily on euphausiids and copepods. It feeds mostly by filtering plankton while swimming (skim feeding) but is also known to gulp-feed on krill, shrimp, and small fish (New York State Department of Environmental Conservation [NYSDEC], 2005). Reduced predation on copepods by other predators, and thus greater abundance of this food source, have increased the reports of sei whales in more inshore locations such as Stellwagen Bank (Waring *et al*., 2004). Mitchell (1975) described two "runs" of sei whales, in June-July and in September-October. The sei whale population migrates from south of Cape Cod and along the coast of eastern Canada in June and July, and returns on a southward migration again in September and October; however, such a migration remains unverified. Sei whales are typically found in deeper offshore waters so it is unlikely to find any in Boston Harbor.

The total number of sei whales in the U.S. Atlantic is unknown. Two estimates by two different methods have estimated the western North Atlantic stock to range from 253 individuals (aerial survey in 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia; Cetacean and Turtle Assessment Program (CETAP), 1982) to between 1,393 and 2,248 individuals (based on a tag-recapture study conducted in 1966-1972 in Nova Scotia (Mitchell and Chapman, 1977). Sei whales are listed as endangered by both the Federal government. There are no reports of fishery-related mortality or serious injury to sei whales in fisheries observed by NMFS during 1991-1997. There are also no reports of mortality, entanglement, or injury in Northeast Fisheries Science Center (NEFSC) databases with the exception of one reported ship strike.

Sperm Whale (*Physeter macrocephalus*) - Sperm whales are generally found on the continental shelf edge, over the continental slope, and into mid-ocean regions and are listed as endangered under the ESA. This offshore distribution is more commonly associated with the Gulf Stream edge and other features as suggested by Waring *et al*. (1993). The best available abundance estimate for sperm whales is from two studies that encompass the area from the Gulf of St. Lawrence to Florida, which estimate the population to be approximately 4,702 individuals.

The sperm whale is the deepest diver of the great whales; it can descend to depths of over 3,300 feet and stay submerged for over an hour. Average dives are 20 to 50 minutes long to depths of 980 to 1,970 feet (American Cetacean Society [ACS], 2004). In winter, sperm whales are concentrated east and northeast of Cape Hatteras. In spring, the distribution shifts northward to east of Delaware and Virginia and is widespread throughout the central portion of the mid-Atlantic bight and the southern portion of Georges Bank. In summer, the distribution is similar to the spring but also includes areas east and north of Georges Bank and onto the continental shelf of New England. In the fall, sperm whales tend to migrate south of New England on the continental shelf. The main food source of the sperm whale is medium sized deep-water squid, but it also feeds on species of fish, skate, octopus, and smaller squid.

There is documentation of sperm whales being entangled in fishing gear. The estimated number of hauls of sperm whales in the pelagic drift net fishery increased from 714 individuals in 1989 to 1,144 in 1990 (Waring *et al*., 2004). In 1999, NMFS issued a Final Rule prohibiting the use of driftnets in the North Atlantic swordfish fishery. Fishing-related mortality or serious injury to the sperm whale decreased to zero from 1991 to 1998. Eighteen sperm whale strandings were documented along the Atlantic coast between Maine and Florida during 1994-2000 (NMFS, unpublished data). The potential for accumulation of stable pollutants such as PCBs, pesticides, PAHs, and heavy metals in long-lived high trophic-level animals is possible, but there is no definitive evidence at this time.

Loggerhead Turtle (*Caretta caretta*) - The loggerhead sea turtle is listed as threatened under the ESA. It is the most common and seasonally abundant turtle in inshore coastal waters of the western North Atlantic. The Turtle Expert Working Group (TEWG) (2000) reports that the South Florida subpopulation appears to be increasing and that no trends are apparent in the northern subpopulation.

Loggerhead turtles are abundant during spring and summer months in coastal waters off New York and the mid-Atlantic states; small numbers of individuals may reach as far north as New England. In New England coastal waters, loggerheads feed primarily on small benthic crabs such as spider crabs, rock crabs, and green crabs, typically in water depths less than 20 m (Burke *et al*., 1990; Morreale and Standora, 1992, 1993). In the fall, loggerheads migrate south to coastal waters off the south Atlantic states, particularly Florida, and to the Gulf of Mexico. During the winter, the turtles tend to aggregate in warmer waters along the western boundary of the Gulf Stream off the Florida coast (Thompson, 1988). In the spring, they congregate off southern Florida before migrating north to their summer feeding ranges (Winn, 1982).

For loggerheads that have not migrated south as water temperatures cool, strandings due to cold stunning may occur, particularly between November and January in Long Island, Rhode Island, and Massachusetts waters. Strandings due to the cold may occur when the water temperature drops below 12 ºC. The metabolic rate of these cold-blooded reptiles decreases to the point where they are unable to swim and digest food; they become comatose and may die if not warmed quickly. Information from strandings, entanglements, mariner reports, and the U.S. Coast Guard suggest that loggerheads can be expected to occur in the project area in the summer and fall months, but most of the strandings are recorded from Cape Cod beaches. The major sources of mortality of loggerheads caused by human activities include incidental take in bottom trawls, particularly shrimp trawls (Henwood and Stuntz, 1987; Thompson, 1988), coastal gill net fisheries, ingestion or entanglement of marine debris, and channel dredging (hopper dredges) (Thompson, 1988; NMFS, 1992). Collisions with vessels and entrainment in electric power plant cooling water may also be causes of loggerhead mortality.

Kemp's Ridley Turtle (*Lepidochelys kempii*) - The Kemp's ridley sea turtle is the most endangered sea turtle in the world. It is distributed throughout coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean and is assumed to constitute a single stock (TEWG, 1998). Juveniles dominate the Atlantic population, but recovery efforts are increasing the population from the low of 500 individuals reported by Carr and Mortimer in 1980. Kemp's ridley population has declined since 1947 when an estimated 42,000 females nested in one day to a nesting population of approximately 1000 in the mid-1980's (NMFS, n.d.).

Although the Kemp's ridley sea turtle is found primarily in the Gulf of Mexico, juveniles do occur during the summer along the Atlantic seaboard from Florida to Long Island Sound, Martha's Vineyard, and occasionally north of Cape Cod, in Cape Cod Bay, Massachusetts Bay, the Gulf of Maine, and as far north as the Canadian Maritime Provinces (Lazell, 1980). Prey species include various crabs and other crustaceans. Although rare, ridleys may visit project areas in Massachusetts Bay and Boston Harbor. Ridleys begin leaving northern waters in mid-September and most are gone by early November. Some may hibernate in nearshore sediments during the winter (Carminati *et al.*, 1994). However, most observed in northern waters after the beginning of November are cold-stunned.

Leatherback Turtle (*Dermochelys coriacea*) - The Federally endangered leatherback turtle is the second most common sea turtle along the eastern seaboard of the United States and is the most common sea turtle north of the 42ºN latitude. Leatherbacks forage in temperate and subpolar waters and nest on tropical beaches. They have a layer of subcutaneous fat and circulatory adaptations to reduce the rate of heat loss through their flippers (Greer *et al*., 1973), thus allowing them to survive and feed in colder temperate waters than other sea turtles.

Because leatherback turtles are a largely pelagic, open ocean species, estimates of their population status and trends have been difficult to obtain. In addition, only a small fraction of the North Atlantic population nests on beaches of the continental United States, mostly in Florida (Meylan *et al*., 1994) and the U.S. Virgin Islands (Boulon *et al*., 1994); others nest on islands in the Caribbean.

Adult leatherback turtles are common during the summer months in North Atlantic waters from Florida to Massachusetts (Goff and Lien, 1988). New England and Long Island Sound waters support the largest populations on the Atlantic coast during the summer and early fall (Lazell, 1980; Prescott, 1988; Shoop and Kenney, 1992). During the summer, leatherbacks move into fairly shallow coastal waters (but rarely into bays), apparently following their preferred jellyfish prey. In the fall, they move offshore and begin their migration south to the winter breeding grounds in the Caribbean (Payne *et al*., 1984).

Being a temperate water species, leatherbacks do not seem to be sensitive to cold temperatures, and strandings cannot be attributed to cold stunning. Leatherbacks are very susceptible to entanglement in shrimp nets and other fishing gear and plastic debris (Mager, 1985; Witzell and Teas, 1994). On their way south in August and September, they often stop in Cape Cod Bay where they occasionally get entangled in lobster pot lines (Mass Audubon, 2003).

Green Turtle (*Chelonia mydas*) - The green turtle is the largest of the hard-shelled sea turtles. The species is distributed throughout the Caribbean Sea, the Gulf of Mexico, and in the western North Atlantic from Florida to Massachusetts. Primary nesting sites are on the east coast of Florida. Current population trends are unavailable. However, since 1980, the number of green turtles nesting each year and the total population of green turtles in Florida waters appear to have increased gradually (Thompson, 1988; Steinback *et al*., 1999).

During the summer, small numbers of green turtles venture as far north as New England. Green turtles are herbivorous as adults and feed in shallow coastal waters on sea grasses and marine algae. Some green turtles become cold-stunned each year by falling water temperatures in the fall and winter, especially in northern waters (Morreale *et al*., 1992). Green turtles occasionally strand on Cape Cod beaches (4 stranding in 2003 (Mass Audubon, 2003)). Natural and anthropogenic disturbances affect green turtles at their nesting locations and in offshore waters. Nesting habitat is lost to erosion, shoreline fortification, and beach renourishment.

3.5 Socioeconomic Environment

Shipping

Maintenance dredging is critical to the economic viability of the region and to ships reaching their destination in Boston safely, reliably and without significant delays. Each year the Port of Boston handles approximately 14 million tons of cargo-including more than one million tons of containerized cargo and 10,000 automobiles. In addition in 2005, 102 passenger ships called on the port of Boston carrying over 230,000 cruise passengers. In recognition of the importance of the marine industry to the State, the Commonwealth has designated areas around the State as Designated Port Areas (DPAs). Four DPAs partially or completely fall within the boundaries of the city of Boston. They are: 1) the Chelsea Creek DPA; 2) the East Boston DPA; 3) the Mystic River DPA; and 4) the South Boston DPA. DPAs benefit the greater Boston region as well as the Commonwealth of Massachusetts in a variety of ways. These benefits, as described by The Boston Harbor Association (2003), include:

- Provide direct economic benefits and job creation through industries including shipping, cruise activity, and fishing processing;
- Generate an indirect multiplier effect on the regional economy through increased opportunities for importing and exporting goods;
- Contain vital regional infrastructure, including key components of the region’s energy supply and preponderance of road salt;
- Protect and maintain the character of Boston’s working port, which serves as both
    - a key source of the city’s historical identity, and
    - a means to differentiate its “sense of place” amidst a landscape of increasingly homogenized American cities; and
- Allow flexibility in responding to unforeseen future marine industrial demands.

The importance of the Designated Port Areas and the attendant result is clear. Each year the working port generates $2.4 billion in economic benefit for the region, directly or indirectly employs over 34,000 workers, provides an economic edge for countless regional businesses, furnishes critical regional infrastructure, and protects and maintains Boston’s maritime character and diverse workforce (Massport, 2005). The support of all marine businesses of all sizes – from shipping terminals to tugboats and salvage companies - is vital to the economy. The DPAs provide a place of affordable rent and financial viability. Without DPAs, these maritime users could fail, threatening the foundations and vitality of the Working Port, as well as the regional economy that is dependent on its use (The Boston Harbor Association, 2003).

Commercial Fishing

Commercial finfishing does not occur within Boston Harbor due to the shipping activity and shallow depths. In contrast, lobsters are commercially fished within Boston Harbor, including the navigation channels. Although lobster fishing occurs in the navigation channels, it is prohibited due to potential impacts to navigation (Section 10 of the Rivers and Harbor Act of 1899. The amount of commercial activity is dependent on the season and the movement of these animals. Questionnaires were sent to commercial lobstermen in 2005 to voluntarily provide information on where and when they fish in Boston Harbor. The following discussion is based on the information received from these surveys. For survey purposes, Boston Harbor was divided into seven areas, five of those areas are pertinent to this project. See the Table 3-13 for area locations.

Table 3-13. Commercial Lobster Fishing Survey Locations

AREA	LOCATION
A	Mystic River
B	Chelsea River
C	Ted Williams Tunnel seaward to Spectacle Island
Y	Ted Williams Tunnel upstream to the Inner Confluence
Z	Navy Dry Dock

No commercial activity, or very little, was reported in the Mystic River and Chelsea River from August through the winter into April. Minor commercial activity in these areas is noted in May, June and July. Areas C, Y, and Z are fished year around, but at varying intensities. More lobstermen fish the Main Ship Channel (areas C and Y) from March through October with a peak in the summer months and early fall. The approach to the Navy Dry Dock is fished most heavily in April, May and June.

Historical and Archaeological Resources

The following narrative is culled from several investigations conducted on behalf of the Corps during planning for the Boston Harbor Deep Draft Navigation Improvement Study Environmental Impact Statement. The subject studies include the following: *Remote Sensing Archaeological Survey and Geologic Interpretation, Boston Harbor Navigation Improvement Study, Boston Harbor, Boston, Massachusetts* prepared by the University of Massachusetts Archaeological Services (UMAS) (Mulholland *et al*., 2003); *Inspection of Magnetic Anomalies, Remote Sensing Archaeological Survey, Boston Harbor Deep Draft Navigation Improvement Study* prepared by the Public Archaeology Laboratory Inc. (PAL) (Robinson and Ford, 2003); and *Archaeological Subsurface Testing for the Boston Harbor Navigation Improvement Study, Boston Harbor, Boston, Massachusetts* prepared by UMAS (Lynch *et al.*, 2004). More detailed information is available in these references. For purposes of this SEIS, a brief summation of the pre-Contact context and Historic Period Shipwreck background for the project area is included.

Pre-Contact Context

The Mystic, Neponset, and Charles Rivers of southeastern Massachusetts, which feed into the Massachusetts Bay Basin, were focal points for Native American occupation for more than 9,000 years. Dena Dincauze's survey of the archaeological resources in the greater Boston area, conducted in 1967-8, included the Boston Harbor islands and revealed the potential for significant archaeological data from sites within the harbor district. A later investigation of the 12 Harbor Islands by Luedtke resulted in the Boston Harbor Islands being nominated as a National Register Historic District. Luedtke's studies confirmed that the harbor islands contained the best-preserved concentration of Native American archaeological sites in the metropolitan Boston area. Currently, 60 documented sites spanning the Early Archaic to the Late Woodland Periods are distributed among 21 islands within the district (Robinson and Ford, 2003).

The Boston Basin area included two core areas of Native American settlement during the Contact Period: the Neponset core situated in the southern part of Massachusetts Bay and the Mystic core situated in the northern portion of the Bay. The Mystic River area included several smaller adjacent coastal river drainages such as the Malden, Pines, and Saugus Rivers. Larger lakes and ponds including Fresh and Spy Pond near the estuary, and Spot Pond and Crystal Lake in the Middlesex Fells formed part of the inland section of the Mystic core area. Contact era sites in the Boston Basin include isolated burial and cemetery locations. Contact Period burials from the Mystic River area are known from West Medford, Winthrop, Revere Beach, and Nahant (Robinson and Ford, 2003).

Historic Period Shipwreck Context

Many historic period shipwreck sites are known to exist in Boston Harbor, with a large number of probable sites within the study area. State and Federal Government compilations of vessel losses date only from the late 1800s and most of these are incomplete (Mulholland *et al.*, 2003).

In addition to any recorded vessel losses, many more were likely lost in Boston Harbor and simply not recorded. Many lost vessels are simply recorded as missing at sea, whether they had just left the harbor, were returning from a long voyage, or were blown in trying to past the shore. In these cases, their actual fate can only be revealed through the efforts of underwater archaeologists. Such vessels would include small and large fishing boats, coasters, transoceanic merchantmen, and warships (Mulholland *et al*., 2003).

Because little is known of the early vessels, how they were made and used, and life aboard the early merchant vessels, the remains of any historic ship or boat would be archaeologically and historically significant on a local, regional, and national level. Historic shipwreck sites in New England are sources that provide archaeologists with information about shipping, vessel construction, lifeways of mariners, and also about early terrestrial life in New England (Mulholland *et al*., 2003).

Major changes took place in shipping during the latter 19th and early 20th Centuries that would affect the number and size of boats and ships lost throughout the United States and especially the Boston Harbor region. During this time, the introduction of important technical and safety innovations allowed seamen to keep their vessels afloat. Engine power, rather than sail and oar, made near shore voyages much safer. First, tugboats, and then internal engines could move a vessel away from danger. Navigation aids along the sides of channels, buoys and beacons, on-shore ranges, and electric navigation lights all assisted small and large vessels navigate through the harbor. Wireless telegraphy and later radio communications helped crews call for assistance and communicate with other vessels. Federal agencies such as the U.S. Life Saving Service and eventually the Coast Guard were established to search for and assist vessels in distress (Mulholland *et al.*, 2003).

All of the potentially significant historic period sites that might be found in the study area would likely be water vessels and their contents. Since Boston Harbor has attracted almost all types of ships, boats, and barges throughout the centuries, the remains of any type of vessel used in the Atlantic during the last four centuries could conceivably be found. There is no complete listing of shipwreck files for the Boston region; however, even incomplete records or compilations suggest a plethora of types, sizes, and cargoes lost in Boston Harbor (Mulholland *et al.*, 2003).

Mostly all recorded shipwrecks are large, transoceanic and coastal ships because until the late 19th Century researchers and the media have been primarily interested in larger vessels. Therefore, the potential for other, smaller vessels in a larger, urban harbor is usually high. The remains of pre-20th Century small oceanic and coastal vessels would be particularly significant due to their archaeologically important cargoes and hulls. However, since these vessels typically did not carry large amounts of iron, they are more difficult to discern through only the use of a marine magnetometer. Additional remote sensing data, including side scan sonar records, would need to be utilized in conjunction with magnetic anomalies to determine the existence of cultural resources (Mulholland *et al.*, 2003).

However, since the proposed project is a maintenance effort that will return the channels to depths already dredged, it is highly unlikely that any historic cultural resources would be encountered in maintenance dredging.

4.0 Environmental Consequences

4.1 No Action Alternative

The No Action Alternative is required to be evaluated as prescribed by NEPA and the Council on Environmental Quality (CEQ). Similarly, the MEPA regulations require projects to evaluate a no-build alternative. The No Action(or no-build) Alternative serves as a baseline against which the proposed action can be evaluated. Evaluation of the No Action Alternative involves assessing the environmental effects that would result if the proposed action did not take place; that is, the Federal navigation channel in Boston Harbor would not be dredged. Failure to dredge Boston Harbor will continue to restrict and delay commercial deep draft vessels. This could cause shippers to bypass the port altogether, significantly impacting the port's viability. It also increases the need for lightering as well as the likelihood of a grounding, both of which could result in adverse environmental consequences.

Areas within the tributaries and navigation channels of Boston Harbor that tend to shoal at a substantially higher than average rate eventually control navigation in the harbor. Not maintaining the channels to the currently authorized depths is increasingly making the port unable to accommodate the present shipping fleet of deep draft container ships and petroleum tankers. With a controlling depth of –35 feet MLLW and a minimum underkeel clearance of two feet, the largest vessel that can enter the Port of Boston without regard to tides draws 33 feet. In 2004 alone, more than 600 movements occurred by vessels with 34-foot or greater drafts in Boston. Limited tidal operations are not consistent with efficient shipping, cargo handling or scheduling. Under the No Action Alternative, more material would ultimately have to be shipped into Boston via barges, necessitating more trips, higher transportation costs, and greater exposure to risks of accidental spills, or by trucks.

Leaving the top layer of silt material in place continues to expose marine organisms that live in or use the area to contaminants. This material is also subject to continual resuspension in the water column during vessel transits in shallower areas. Removing and confining the material reduces this risk of exposure. As the harbor becomes cleaner, silt filling the navigation channels may be more beneficial to marine life. Thus, removing the unsuitable silty material now, could potentially increase the long-term environmental benefit. Environmental or economic benefits accrued by leaving this material in place are few.

4.2 General Impacts of Dredging and Disposal in Boston Harbor

Sediments and other materials suspended in a water body are referred to as total suspended solids (TSS) and are measured in milligrams of solids per liter of water (mg/L). Turbidity, a related parameter, is an expression of the optical properties of water that cause light to be scattered and absorbed rather than transmitted in a straight line. During dredging, a plume would be created containing elevated levels of suspended sediments and associated contaminants. The three broad categories of sediment plume impacts are physical, chemical and biological. Sediments temporarily suspended during dredging and disposal can affect aesthetics, light penetration, feeding by benthic organisms and fish, and, at very high levels, can destroy or injure fish and benthic organisms. Therefore, concentrations of TSS, resulting from dredging and disposal operations, over time can be predicted either through modeling or previous monitoring to assess potential impacts. Contaminants within the sediments to be dredged may dissolve when the dredged material is exposed to the water column that can kill or impair marine animals if they are exposed to high concentrations over a sufficiently long period of time. The following sections describe the potential impacts from dredging and disposal to the physical, chemical and biological environment, and the lessons learned from monitoring during the BHNIP.

Physical Impacts from Dredging and Disposal in Boston Harbor

Dredging Impacts

All types of dredges create some form of sediment plume in the water column. The nature, degree, and extent of dredged material dispersion around a dredging operation are controlled by many factors (Barnard, 1978 in Herbich and Brahme, 1991). These factors include the characteristics of the dredged material such as its size distribution, solids concentration, and composition; the nature of the dredging operation such as the dredge type and size; and the characteristics of the hydrologic regime in the vicinity of the operation, including salinity and hydrodynamic forces (waves, currents, etc.). The relative importance of these factors varies from site to site. The amounts of sediments suspended during dredging are generally highest in the immediate vicinity of the dredging operations and return to background levels within a short distance of the dredging site.

Bohlen *et al*. (1979), estimated that 1.5% to 3.0% of the volume of substrate (fine-grained sands and silts) contained in an open clamshell dredge bucket is introduced into the water column. However, a number of operational variables, such as bucket size and type (open or enclosed), prohibiting scow overflow, volume of sediment dredged per cycle, operator experience, hoisting speed, and hydrodynamic conditions in the dredging area can significantly affect the quantity of material suspended (LaSalle, 1988; Lunz *et al*., 1984). Sediment resuspension from clamshell dredges can be reduced by using an enclosed clamshell bucket or by slowing the raising or lowering of the bucket through the water column. The latter reduces the production rate of the dredge (Hayes, 1986). An enclosed bucket was used to dredge the material unsuitable for open water disposal during the BHNIP.

A substantial amount of information about TSS concentrations and turbidity plumes was collected during dredging and disposal of Phase 1 (Conley Terminal) and Phase 2 of the Boston Harbor Navigation Improvement Project (BHNIP). This information, in conjunction with information from the New Haven Harbor and Providence River dredging projects, was used to predict anticipated turbidity and TSS impacts to the water column in the area of the dredging operation for this Inner Harbor Maintenance Dredging Project (IHMDP).

New Haven

Monitoring of dredge induced suspended sediment concentrations was conducted at New Haven Harbor under the Army Corps of Engineers, Disposal Area Monitoring System (DAMOS) Program to address concerns relative to winter flounder spawning grounds near the Federal channel (Corps, 1996). Dredging at New Haven Harbor was conducted with an enclosed bucket. The sediments from New Haven Harbor are similar to the sediments in Boston Harbor. The two major objectives of the New Haven monitoring were to 1) establish the background suspended solids concentration before and after dredging, and 2) document the movement of the dredge plume relative to fisheries resource areas such as winter flounder spawning grounds.

The results of the acoustic survey revealed that the dredge-induced sediment plume did protrude into the shoal areas to the east and west of the navigation channel. These excursions onto the shoals only occurred when the dredge was in the immediate vicinity. The DAISY (Disposal Area In-Situ System), which was deployed on the eastern end of the winter flounder spawning area, also showed elevated suspended materials concentrations attributable to the dredge operating in the upper reaches of the harbor. The time series of the DAISY data showed numerous aperiodic short duration spikes of 100 mg/L. The observed concentrations were an order of magnitude higher than the preceding background concentrations. However, in the last half of the deployment, while the dredge was located well south of the DAISY site, there were several long duration (1-3 days), and very high perturbations. During these events concentrations reached 700 mg/L that could not be related to the dredging operation. Evidence from the meteorological data and wastewater effluent records indicate that these events are likely the result of winds and wind-generated waves, alone or in combination with discharges from wastewater treatment plant outfalls.

Based on these findings, dredged induced sediment resuspension is a minor perturbation to the much longer duration, larger amplitude events associated with wind, wind-waves, and effluent discharges from outfalls. The effects of dredge related spikes in suspended sediments on the winter flounder spawning grounds, and the regional water quality in general, appear limited in duration and of relatively low amplitude (Corps, 1996).

Boston Harbor

Monitoring was conducted as specified in the Water Quality Certification (WQC) for dredging of the surface silty material during construction of the first confined aquatic disposal (CAD) cell for Phase 1 of the BHNIP. This monitoring included: 1) documentation of the spatial and temporal distribution of the sediment plume for the four extremes of tidal currents (high water slack, maximum ebb, low water slack, maximum flood) on two days within the first week of dredging; 2) collection of water samples from the lower half of the water column at two locations – 1,000 feet up current of the dredging and 500 feet down current from the dredging; 3) analysis of water samples for TSS. Additional parameters (turbidity, DO, arsenic, and copper) were analyzed when dredging the parent material.

During dredging, turbidity measurements ranged from 3-5 NTU (Nephelometric Turbidity Units) at the reference station 1,000 feet up current from dredging the silty surface material using an environmental bucket. Turbidity was only slightly elevated at the station 500 feet down current of the dredging ranging from 4-11 NTU. TSS ranged from 4-5 mg/L at the reference station and from 5-9 mg/L at the down current station. No plume was visible at the surface outside the immediate area of the dredging operation, and no significant plume was detected in the water column (ENSR, 1997).

Suspended solids in the water column were visible for a greater distance when dredging the parent material, which contained comparatively higher amounts of fine clay, during CAD cell construction with an open clamshell bucket (ENSR, 1997). Turbidity measurements ranged from 3-7 NTU at the reference station 1,000 feet up current of the dredging, while 300 feet down current of the dredging turbidity ranged from 8-56 NTU. TSS ranged from 8-60 mg/L at the reference station and from 19-48 mg/L at the down current station. All values were well below the 200 mg/L performance criteria established by the WQC for a point 500 feet down current of the dredging.

Monitoring of the turbidity plume associated with dredging of silty maintenance material (using the environmental bucket) was performed on one occasion during Phase 2 of the project in September 1998 (Normandeau, 1998b). Mapping of the turbidity associated with use of the environmental bucket to dredge maintenance (silty) material in Boston Harbor was required as part of the WQC for the BHNIP. Monitoring was performed during periods of high and low water slack and during maximum flood and ebb tides in the Mystic River. The mapping required generation of plan views of turbidity at mid-depth and near bottom extending from 300 feet up current to 1,000 feet down current of continuous dredging operations. Generation of a cross section of turbidity located 300 feet down current of the dredging was also required.

Near bottom turbidity values were highest for all measurements with values no higher than 100 NTU approximately 300 feet down current of the dredging operation. Mid-depth turbidity was much less, and all values returned to background levels (10-20 NTU) between 600 and 1,000 feet down current (ENSR, 2002). A separate monitoring trial was performed when the dredging contractor (Great Lakes Dredge and Dock Company [GLDD]) proposed to use their own environmental bucket (in addition to the approved Cable Arm bucket).

The WQC for the BHNIP required the use of a closed environmental bucket for maintenance dredging. The bucket manufactured by Cable Arm® was specified as acceptable, and other closed buckets could be used if they could meet specified performance standards of suspended solids not to exceed 25 mg/L over background and turbidity not to exceed background by more than 30% at 75 feet from the dredge.

Monitoring of GLDD’s closed environmental bucket was performed in September 1998 (Normandeau, 1998b). The bucket met the performance standard for total suspended solids, but not for turbidity. It was noted that the turbidity standard (not to exceed 30% above background at 75 feet) was a much more stringent standard for the conditions of this test when compared to the TSS. With a background turbidity of three NTU, the resulting performance threshold at 75 feet was only four NTU. Consequently, the MA Department of Environmental Protection (DEP) ultimately allowed the use of the environmental bucket based on its performance as related to suspended solids (ENSR, 2002). A more detailed bucket study performed by the Corps’ Engineer Research Development Center was also conducted in August 1999 during the BHNIP.

A conventional (open-faced) clamshell bucket, a Cable Arm clamshell bucket, and an enclosed environmental clamshell bucket were evaluated relative to sediment resuspension and loading characteristics under similar operating and environmental conditions in Boston Harbor during August 1999 (Welp *et al*., 2001). Monitoring was conducted to characterize each bucket's near and far field sediment resuspension characteristics.

Sediment resuspension data consisted of suspended solids samples and turbidity measurements collected within 26 feet (in the horizontal plane) of the bucket position (near field) and 82 to 1312 feet from the dredge (far field). Near field data included continuous turbidity measurements taken at four depths (5, 18, 26, 34.5, and 38 feet in a water depth of about 38 feet) and discrete water samples were analyzed for TSS. Far field data included indirect turbidity observations using a Broad Band Acoustic Doppler Current Profiler (BBADCP), and direct turbidity, conductivity, temperature measurements, and direct water samples for TSS analysis collected by the Battelle Ocean Survey System (BOSS). The BBADCP collected acoustic measurements of the suspended sediment plume to produce images of the relative distribution of suspended-sediment concentrations in the water column.

Near field monitoring results showed that the conventional bucket generated the highest turbidity and suspended sediment, probably because of loss of sediments from the open top. The conventional bucket distributed turbidity throughout the water column. The TSS ranged from 105 mg/L in the middle of the water column to 455 mg/L near the bottom. Average turbidity varied a bit less and ranged from 46 to 64 FTU (formazin turbidity units). Although both the Cable Arm and the GLDD enclosed bucket leaked substantially through the seals and grated vents in the upper part of the buckets, neither resulted in as much turbidity or TSS as the conventional bucket. The depth-averaged turbidities were 57 FTU, 31 FTU and 12 FTU for the conventional bucket, Cable Arm and GLDD enclosed buckets respectively. The depth averaged TSS values for the conventional bucket, Cable Arm and enclosed buckets were, respectively, 210 mg/L, 31 mg/L and 50 mg/L. The most significant difference was in the middle water column where turbidity values were substantially less than at the bottom or near the surface. Turbidity for the Cable Arm bucket ranged from 6 to 55 FTU, and TSS from 14 mg/L to 66 mg/L. The GLDD enclosed bucket resulted in turbidity from 1 to 31 FTU and TSS from 14 to 112 mg/L.

The above results show that a turbidity plume can be produced during dredging but is generally limited to the immediate vicinity of the dredge. An environmental bucket or Cable Arm bucket can reduce the amount of suspended solids in the water column.

Disposal Impacts

CAD cell monitoring for both the Providence River Project and the BHNIP are described in this section. In order to assess water quality impacts associated with CAD cell disposal operations for the Providence River and Harbor Maintenance Dredging Project (PRHMDP), a comprehensive water quality monitoring program was conducted by the Corps (Corps, 2001), from the initiation of disposal operations in accordance with specifications outlined by the Water Quality Certification issued by the Rhode Island Department of Environmental Management (RI DEM) (March 20, 2003). The purpose of this monitoring was to ensure compliance with the State of Rhode Island Water Quality Standards. It included real-time plume tracking using Acoustic Doppler Current Profiling (ADCP), vertical profiling and the physical, chemical and biological testing of water samples (including turbidity profiling, dissolved oxygen monitoring, total suspended solids, dissolved metals and toxicity testing). The timing and intensity of the monitoring was triggered by specific disposal events (i.e. first disposal event at high tide, low tide disposal within the first 11 events, disposal when cell contents are within 20 feet from the top of the cell) with the results compared to specific project compliance criteria along downfield transects. The results of this monitoring showed that the sediments resuspended by the disposal events (and dredging) generally returned to background levels within 500-800 feet of the disposal cell and no elevations were observed beyond 1,800 feet down current at the compliance point, even when the dredges were working adjacent to the disposal cell. No criteria exceedences for either the selected dissolved metals or toxicity were encountered at the 1,500-foot downstream compliance location(s). In addition, non-required samples collected for chemical and biological analysis directly within the disposal plume immediately following disposal showed no significant effects (Corps, 2005).

In Boston Harbor, turbidity and TSS measurements were collected for disposal of the silty surface material into the CAD cell for Phase 1 of the BHNIP (ENSR, 1997). Turbidity measurements ranged from 2-14 NTU for the reference location. At the location 300 feet down current of the cell, turbidity ranged from 1-30 NTU with the highest measurements recorded during the fifth monitoring event. Some of the elevations in turbidity were attributed to vessel traffic unrelated to the project.

TSS concentrations ranged from 3-29 mg/L for the reference location. At the location 300 feet down current of the cell, TSS concentrations ranged from 5-64 mg/L with the highest concentrations recorded during the fifth monitoring event one hour after disposal (ENSR, 1997). As with turbidity, some of the elevations in TSS are attributed to vessel traffic unrelated to the project.

Plume tracking following disposal of silty material from scows into a CAD cell was performed five times during Phase 2 of the BHNIP (Normandeau, 1998d,e, 1999b,e,f, 2000a). The mapping required generation of plan views of post-disposal turbidity at the surface, mid-depth, and near bottom extending from 200 feet up current to 1,000 feet down current of the disposal cell at 1-2 hours following disposal. This more detailed plume monitoring further supported the results of the turbidity measurements, discussed below (i.e. elevations of turbidity generally remained within the boundaries of the disposal cell itself, with limited down current transport). Although not a formal "plume tracking" event (the measurements were made during water quality sampling), the disposal of approximately 7,200 cy of silty maintenance material from three scows within one 3-hour, high-tide disposal window into the Supercell in the Mystic River, made it one of the largest disposal events of the project. Measurements were performed approximately one hour after the last disposal into the cell, well into ebb tide conditions. Elevated turbidity extended beyond the cell boundaries, but a significant plume was not identified beyond 300 feet down current of the cell (ENSR, 2002).

An additional 18 water quality events, including turbidity and total suspended solids, were also monitored during the BHNIP (Normandeau, 1998a,c,f, 1999a,c,d,g-n, 2000a). Following the disposal event and departure of the tug/scow, turbidity measurements were generally performed directly over the CAD cell to assess plume potential and verify current direction. Values greater than 1,000 NTU were often detected below the rim of the cell, with elevations of 100-200 NTU in the water column above the cell. Down current from the cell, at the 300-foot compliance point, elevations of turbidity above 100 NTU were detected in only a limited number of events and were short term (minutes) in duration. In general, highest turbidity measurements at the 300-foot down current location were 20-30 NT above background at the 0.5 and 1.0 hour sampling times. The highest values were generally found in the lower half of the water column. Turbidity generally returned to near background levels by the 4-6 hour sampling time (ENSR, 2002).

Total suspended solids measurements were collected at the same time as turbidity (Normandeau, 1998a,c,f, 1999a,c,d,g-n, 2000a). Background concentrations of TSS generally ranged from 5-15 mg/L. Concentrations at the 300 foot down current locations were generally higher than background by a factor of two to four at the 0.5 and 1.0 hour sampling times. Concentrations returned to near background levels at the 4-6 hour sampling time (ENSR, 2002).

The WQC for the BHNIP also specified that disposal into CAD cells occur during a 3-hour window around high tide (one hour prior to two hours following predicted high tide). The aim of this requirement was to have the disposal occur during a lower current portion of the tide cycle and maximize the available water column for dilutions of any contaminants released during disposal. However, a disadvantage of this requirement was that vessels transiting the port often schedule their arrival or departure with the high tide to provide extra water depth for maneuvering. As a result, the dredging contractor would sometimes accelerate their schedule to ensure that a disposal would take place prior to the scheduled arrival or departure of a vessel. If disposal was postponed until after the vessel finished maneuvering in the area, the disposal time window may have closed.

The WQC required that the disposal not be performed when vessels were within 1,000 feet of the disposal cell. However, there were no requirements for timing the disposal in relation to vessel passage. As a result, accelerating the schedule to complete a disposal event prior to the arrival/departure of a vessel meant that vessels were occasionally maneuvered over the cell within a very short time (minutes) following a disposal event before much of any settling had occurred within the cell. This could potentially result in an increased loss of suspended material from the cell, and was presented as potential cause of some cell material discovered down river of cell M12.

As the monitoring progressed and no water quality issues were noted, GLDD requested that disposal be allowed during a low tide window to allow for greater flexibility in disposal and to aid in avoiding disposal/vessel passage conflicts. A conditional 2-hour window was granted (from predicted low tide until two hours after) with provisional monitoring (Normandeau, 1999l,n). The results of the monitoring were similar to that performed during high tide (limited turbidity plume development with no criteria exceed). Low tide disposal was allowed for the remainder of the project. Because there was no difference in impacts during monitoring the two hours at low tide and the three hours at high tide, we are proposing to extend the two hour disposal window at low tide by one hour for a total of three hours. This would give the Contractor the same amount of time (three hours) to dispose of material at low slack tide as high slack tide.

The TSS and turbidity monitoring results summarized above show that disposal of silty material into the CAD cells did not cause significant water quality impacts or exceed water quality standards as required in the WQC.

Additional CAD Cell Evaluations

The proposal to leave cells open longer for consolidation prior to capping coupled with the discovery of dredged material down river of cell M12 led to an additional BHNIP WQC requirement to evaluate resuspension over an uncapped cell. The field component of the study included assessment of sediment resuspension resulting from the passage of a 900-foot long, 35-foot draft (83% of the water column) liquefied natural gas (LNG) tanker over a capped and uncapped cell in the Mystic River. The LNG *Matthew* was chosen because of its large size and its predictable schedule based on requisite pre-arrival/departure notification to the U.S. Coast Guard.

Temperature, salinity, turbidity, currents, and TSS were collected from seven transects from the Mystic River out to the Inner Harbor. Measurements were taken prior to the tankers departure from the berth in the Mystic River, during vessel wake and one hour later. Background TSS levels were < 10 mg/L. The LNG was assisted by four tugs until the tanker reached the Tobin Bridge. TSS levels were < 40 mg/L within several feet of the bottom after the wake of the LNG *Matthew*. Results (SAIC, 2000) indicate that < 1 cy of sediment is resuspended per cell for each vessel passage. Uncapped cells had slightly higher resuspension than capped cells (cells were capped with sand). The resuspended sediment settled within an hour, and appeared to remain predominantly within the cell. Also, the volume of resuspended sediment was greater in the navigation channels towards the Inner Confluence and Inner Harbor (where no disposal cells were located), most likely due to the higher speeds of the LNG tanker, indicating that leaving the cells uncapped for a period of time does not result in a significant increase in suspended solids.

Chemical Impacts in Boston Harbor

Dissolved organic and inorganic contaminants in the environment may become adsorbed to sediment particles that can affect water quality during the dredging process. Potential chemical impacts from resuspended sediments include the disassociation of these contaminants from sediment particles.

Contaminants

Water quality monitoring was performed during Phase 1 and Phase 2 of the BHNIP during disposal of sediments into the CAD cells. The WQC for both phases of the project specified a series of monitoring events "to maintain water quality, to minimize impact on waters and wetlands, and to ensure compliance with appropriate State law".

Phase 1

For Phase 1 monitoring, total PCB, dissolved arsenic, cadmium, chromium, copper, lead, nickel, zinc and total mercury were analyzed or archived at the reference station, 300 and 1,000 feet down current of the cell during disposal operations (ENSR, 1997). Results showed no detectable elevations within the water column for PCB, cadmium, nickel, arsenic, or chromium during the five monitoring events. Copper was detected in the majority of the samples collected, at both reference and down current sampling locations. Lead was not detected in the first four monitoring events. Lead was detected in all samples on the fifth monitoring effort (both reference and down current) with a maximum concentration of 0.06 ug/L. All concentrations were well below the chronic water quality criterion of 8.1 ug/L. Zinc was detected in all the samples collected with a maximum concentration of 2.6 ug/L. There was no obvious difference between reference and down current stations, and all values were well below the chronic water quality criterion of 81 ug/L.

Total mercury was not detected in any samples from the first two monitoring events. During the third and fourth monitoring events, mercury was detected in the down current samples collected at 0.5 and 1.0 hours after the disposal event with a maximum concentration of 0.011 ug/L (below the chronic water quality criterion of 0.025 ug/L). During the fifth monitoring event, mercury concentrations were below detection limits at the reference station and above chronic water quality criterion, but not above acute water quality criterion, for the 0.5 and 1 hour samples at the down current station (at concentrations of 0.04 and 0.034 ug/L, respectively). The 12-hour composite sample from the down current station was 0.01 ug/L. As this composite value was below the chronic water quality criterion, the results of this sample, and all of the samples, were in compliance with the standards set in the WQC for the project (ENSR, 1997). No impacts to water quality were observed during Phase 1 of the BHNIP during CAD cell disposal events for selected parameters.

Phase 2

Water quality monitoring results from Phase 2 of the Boston Harbor Navigation Improvement Project (Normandeau, 1998a-f, 1999a-n, 2000a) showed no exceedences of water quality standards during disposal of dredged material within excavated cells in the Federal channel. In addition to the physical parameters discussed in the previous section, additional chemical parameters were measured during Phase 2 operations and include total arochlors PCBs, total mercury, and dissolved cadmium, lead, copper, arsenic, nickel, zinc, and chromium. These parameters were measured 300 feet down current of the dredge at 0.5 hour, one hour and 4-6 hours after disposal of dredged material into the CAD cell. The following criteria were established in the WQC:

- Acute water quality criteria were required to be met for specific parameters at a location 300 feet down current of the disposal cell for individual water samples collected 0.5 and 1.0 hours following disposal. An exceedence was defined as any value above the criteria that was also 30% higher than the relevant reference value.

- Chronic water quality criteria were required to be met for specific parameters at a location 300 feet down current of the disposal cell for composite water samples collected four to six hours following disposal. An exceedence was defined as any value above the criteria that was also 30% higher than the relevant reference value.

There were no water quality criteria exceedences for all measured parameters during disposal operations. Monitoring results showed that arsenic or cadmium was not detected in any of the water samples. Chromium was detected on one occasion at 10 ug/L with similar background concentrations. Copper was detected in approximately half of the samples ranging from 0.5-2.6 ug/L (with one anomalous sample of 69 ug/L). The highest concentrations were found at background locations. Lead was detected in most samples at < 0.3 ug/L with similar background concentrations. Zinc was detected in all samples ranging from 2-6 ug/L with similar background concentrations. Total mercury was detected in most samples, generally < 0.02 ug/L. On four occurrences, concentrations exceeded the chronic water quality criterion (0.025 ug/L), with values ranging from 0.030-0.036 ug/L. These concentrations all occurred at the 300-foot down current location at 0.5 or 1.0 hours after disposal (which was designed to measure acute, not chronic criteria), and the elevations were apparently the result of disposal. In each of these cases, concentrations in the 4-6 hour samples had dropped below the chronic criterion. PCBs were only detected during two monitoring events, with the highest concentration (0.19 ug/L) occurring at a background station.

Dissolved Oxygen

Dissolved oxygen (DO) measurements were taken during disposal of silty surface material into the CAD cell for Phase 1 of the BHNIP at the reference point, 300 feet down current and 200 feet lateral of the cell, and 1,000 feet down current of the cell (ENSR, 1997). DO concentrations ranged from 6.4-8.2 mg/L over the five monitoring events. There was no apparent difference between reference and down current locations. Lower DO concentrations were consistently noted at all monitoring locations during the later stages of ebb tide.

For Phase 2 water quality monitoring, DO levels varied widely from 4-11 mg/L as the monitoring was performed throughout the year (ENSR, 2002). However, during any given monitoring event, background and down current concentrations were very similar.

After completion of the first round of capping, the elevations of the tops of capped cells M4, M5, and M12 ranged from 9 to 15 feet below the surrounding harbor bottom. Concern was raised that the DO levels might be further lowered due to reduced circulation over the depressed CAD cells. MA DEP amended the WQC to require measurement of DO in near bottom (within three feet) waters over the three cells and in surrounding waters during the months of July-October 1999 (Normandeau, 2000b).

DO levels displayed a clear decrease as water temperatures increased in the late summer, with values dropping below the State’s 5.0 mg/L standard. However, the decrease was similar to that noted in the surrounding areas beyond the boundaries of the cells (ENSR, 2002). Although the high organic content of the newly exposed dredged material in the cells was expected to cause anoxic conditions at the sediment-water interface, the depressed nature of the cells did not appear to affect dissolved oxygen content of the immediate overlying waters.

Biological Impacts in Boston Harbor

Most shallow benthic habitats in estuarine systems are subject to deposition and resuspension events on daily or even tidal time scales (Oviatt and Nixon, 1975). Many organisms have behavioral or physiological responses to sediments that settle on or around them. Many organisms avoid the area of disturbances while others have a tolerance to attenuated light conditions or anaerobic conditions caused by partial or complete burial. Direct effects of sedimentation include smothering, toxicity (exposure to anaerobic sediment layers), reduced light intensity, and physical abrasion, where as indirect effects include changes in habitat quality (Wilber *et al.*, 2005).

Studies of burial of estuarine invertebrates found species specific responses. According to Hinchey *et al*. (in Berry *et al*., 2003), the responses varied as a function of motility, living position and inferred physiological tolerance of anoxic conditions while buried. The deposition of dissimilar sediments has a greater impact on organisms than sedimentation of like materials (Maurer *et al*., 1978, 1986). In the navigation channel, the benthic community already experiences and has adapted to sedimentation stress caused by resuspension of sediments due to large vessel traffic. Monitoring of previous dredging activities has shown that any sediment plumes settle out predominantly in the dredge area (see Section 4.2 General Impacts of Dredging and Dredged Material Disposal in Boston Harbor) limiting the extent of additional stress to the system.

Temporary increases in turbidity can have a short-term localized effect on the benthic community and potential effect on fish. Effects associated with turbidity include reduced vision and masked odors, both of which are important to foraging organisms. Suspended silts may also clog or abrade gill structures and interfere with feeding mechanisms of filter feeders. The usually high organic content of silt/clay material would reduce ambient, dissolved oxygen concentrations. Increased turbidity would reduce light penetration lessening primary productivity, and, therefore, oxygen release from primary producers would be lessened. Finally, upon settling, the suspended sediment load could cover non-motile plants and animals.

Turbidity impacts are dependent on the concentration and the duration of the suspended sediments (Clarke and Wilber, 2000). Motile organisms can generally avoid unsuitable conditions in the field. Under most dredging scenarios, fish and other motile organisms encounter localized suspended-sediment plumes for exposure durations of minutes to hours, unless the organism is attracted to the plume and follows its location. Adult fish responses to suspended sediments for durations of less than one day at concentrations $\leq$1,500 mg/l, i.e., conditions relevant to most dredging project scenarios, have not been sufficiently studied to reach definite conclusions (Clarke and Wilber, 2000). Fish eggs and larvae are more sensitive to suspended sediment impacts than older life history stages; however, most of the available data for eggs and larvae pertain to freshwater conditions (Clarke and Wilber, 2000).

Although adult bivalve mollusks are silt-tolerant organisms (Sherk, 1972 in Clarke and Wilber, 2000), they can be affected by high suspended sediment concentrations. Hard clams (Pratt and Campbell, 1956 in Clarke and Wilber, 2000), and oysters (Kirby, 1994 in Clarke and Wilber, 2000), exposed to fine silty-clay sediments have exhibited reduced growth and survival, respectively. Suspended sediment concentrations required to elicit these responses and mortality, however, are extremely high, i.e., beyond the upper limits of concentrations reported for most estuarine systems under natural conditions, as well as typical concentrations associated with dredging operations. Sublethal effects, such as reduced pumping rates and growth, were evident for adult bivalves at concentrations that occur under natural conditions, but may be of a short-term (i.e. hours to days) duration, for example, during a storm (Schubel, 1971; Turner and Miller, 1991 in Clarke and Wilber, 2000). As with estuarine fish, the egg and larval stages of shellfish are more sensitive to suspended sediment impacts than adults. Estimates of suspended sediment impacts to these pelagic, early life history stages must consider the local hydrodynamics of the dredging site, which strongly influence the likelihood of extended exposure to suspended sediment plumes (Clarke and Wilber, 2000).

The benthic community in the navigation channel will be destroyed by direct removal from the dredge. Once dredging is completed, the benthic community is expected to return to pre-dredge conditions within a relatively short period of time (months in some cases), depending on the time of year of disturbance. The Benthic Subsection of the Affected Environment (Section 3.0) presents details on benthic communities that were sampled about three years after being dredged. Studies by McCauley *et al*. (1977) in Oregon indicated that pre-dredging conditions in a channel could be reestablished in as little as 28 days after dredging ceases. However, complete recolonization by sedentary adult forms of many pre-dredging organisms could take up to several years. Physical substrate conditions, however, would be essentially the same in these areas both before and after the project, and organisms inhabiting the surrounding regions would quickly recolonize the impacted areas.

Most mobile organisms living on the surface would be displaced during dredging operations, but would return as benthic organisms recolonize the area and are available to serve as a food source. Some motile organisms such as crabs and lobster are not always capable of leaving their shelter due to physiological circumstances such as molting or cold temperatures in which case dredging would directly impact these individuals.

<u>Biological Water Column Tests</u>

Biological testing was also performed to investigate water quality impacts on aquatic organisms associated with disposal of silt (maintenance) material into the CAD cells during Phase 1 and 2 of the BHNIP (ENSR, 1997, 2002; Normandeau, 1998a and 1999c,j). The results showed that both phases of the BHNIP were in compliance with the water quality standards set in the WQC.

No acute or chronic toxicity was revealed during Phase 1 of the BHNIP seven day bioassay test to the mysid shrimp *Mysidopsis bahia.* The tests did reveal a chronic sublethal impact on egg fertilization for the purple sea urchin *Arbacia punctulata*. However, the measured impact was identical at the reference and down current location, indicating that the impact was an apparent background condition of the harbor and not the result of dredging (ENSR, 1997).

Water samples were collected four to six hours following disposal at a location 300 feet down current of the disposal cell during Phase 2 of the BHNIP. The water samples were used for the sea urchin fertilization test and the mysid shrimp chronic endpoint seven day test. Bioaccumulation of metals and organics were assessed in the blue mussel. Mussel deployment locations were set to further identify bioaccumulation impacts associated with disposal into the CAD cells.

The mysid shrimp test revealed at or near 100% survival for all samples and no differences in growth between the reference site and down current of the disposal cell. For the sea urchin test, fertilization was approximately 90% for all samples in the February 1999 test. For the August 1998 test, low fertilization (<33%) was recorded for both the down current and location and the reference site, indicating an impact unrelated to the project (ENSR, 2002).

Blue mussels were deployed upstream and downstream of the Mystic River disposal cells, and at a reference location farther down river. Cadmium was not accumulated at any of the stations. Mercury concentrations in the mussels were similar at all stations. Arsenic concentrations varied with no discernable pattern. Lead concentrations varied by a factor of four. The distribution of concentrations at some locations showed a pattern consistent with potential impacts due to disposal cells, but the investigation was not wide enough in scope to identify project-specific impacts versus impacts associated with normal harbor processes (ENSR, 2002). Bioaccumulation of organics showed a consistent pattern of highest concentrations upstream decreasing to lowest concentrations farther out of the harbor for both PAHs and PCBs. This pattern is consistent with an upriver source, such as a CSO (combined sewer overflow) discharge, unrelated to the project (ENSR, 2002).

Based on this data, no significant column impacts would be expected to occur as a result of CAD cell disposal operations.

Fisheries

Minimal levels of sedimentation can potentially have an adverse impact on early and/or critical life stages of fish and shellfish. Sediments have the potential to bury demersal eggs, while larvae may be trapped or buried by the sediments (Wilbur and Clarke, 2001; Berry *et al*., 2003). Winter flounder is a Federally managed demersal (bottom dwelling) fish that is commercially exploited and found in the project areas. Winter flounder eggs are demersal and larvae are found near the bottom in shallow areas. However, since winter flounder spawn on clean sand, the silty navigation channel would not be considered spawning habitat for winter flounder.

Monitoring from BHNIP showed that the dredging plume was generally localized to the immediate dredge area (within 600 feet) irrespective of tide direction and stayed within the navigation channel (Normandeau, 1998c-f, 1999a,b,d-i,k-n, 2000a). Therefore, it is expected that most of the suspended sediments from dredging operations will resettle in nearby areas. Consequently, any impacts associated with sediment resuspension and transport are expected to be limited to the near-field areas. Also, plume modeling of the Boston Harbor Outer Harbor Maintenance Dredging Project using the SSFATE model (Corps, 2003b) showed that the bottom thickness of deposited sediment would not be measurable (less than 0.1 millimeters). Only in the immediate vicinity of the dredge did the bottom thickness from suspended solids increase to the 0.5 to 1.0 millimeter range. This is still a very small increase, and most likely within the normal range caused by harbor activities, such as ship passage and storm activities. Suspended solids within the mid-level of the water column showed that the plume stayed fairly localized to the area of dredging, mostly within the navigation channel, and did not greatly increase the amount of sediments in the water column over Boston Harbor's natural background. Additionally, the results of the SSFATE model indicated that no appreciable amount of suspended material from dredging would migrate to the winter flounder habitat areas in Winthrop or Logan tidal flats.

Since the turbidity plumes tend to be limited to the local vicinity of the dredge, and flounder eggs would not be expected to settle in areas subject to constant disturbance such as the navigation channel, it is expected that (little to no increase in) minimal sediment deposition is anticipated to occur in areas containing eggs or larvae. Therefore, project activities are expected to have little if any impact on winter flounder eggs or larvae. Juveniles and adults of demersal fish are motile and have the ability to swim away from any disturbances caused by dredging activities.

Dredging is not expected to have a significant impact on anadromous fish species migrating towards their spawning areas. Anadromous fish such as smelt, alewife, and blueback herring use Boston Harbor, the Mystic River and Chelsea River, for passage to upstream spawning locations. These species spawn in freshwater that is upstream of the project area. Turbidity studies conducted for the previous BHNIP, and discussed in the above sections, indicated that the turbidity only affected a small portion of the cross section of river at the time of dredging. No large schools of fish were observed in the vicinity of cell excavation or disposal. Although the fish were deterred by the activities, there was no evidence that construction presented an overall impediment to fish passage (ENSR, 2002) given the dredge footprint and nearfield water quality impact. It is not expected that any activities from this dredging project would prevent upstream passage of these fish. However, as a precaution, a fisheries observer, sonar detection, and a startle system from February 15 to June 15 will be required for the Mystic River and Main Ship Channel CAD cell disposal activities.

The MA Division of Marine Fisheries (DMF) has identified suitable shellfish habitat for softshell clams, blue mussels, and razor clams in the vicinity of some of the dredge areas. No significant populations of shellfish are noted in the navigation channels. However, the presence of softshell clams was confirmed by one grab sample collected in the Chelsea River outside the navigation channel. Any shellfish in the channel areas to be dredged will be removed and destroyed. Any shellfish inhabiting the surrounding areas are not expected to be significantly impacted by sedimentation given the proximity to the dredging/disposal operations and because the shellfish beds are located close to shore. Any shellfish inhabiting adjacent areas near the navigation channel would be expected to be capable of tolerating short-term temporary increase in suspended sediments such as experienced during ship traffic or naturally occurring storm events.

Lobster Investigations

Lobsters are present in Boston Harbor and the larger class sizes are likely to inhabit the navigation channel in the same manner as they use the habitats outside the dredge footprint. The larger lobsters are motile and have the ability to leave any area of disturbance, except during the winter when movements are restricted due to the cold temperatures or when molting (Cobb, 1976). The early benthic phase (EBPs) and juvenile lobsters that need shelter for survival tend to inhabit the more shallow areas outside the navigation channel and along island coastlines, and not in depositional areas such as the Inner Harbor, Mystic and Chelsea River channel areas, as discussed in the Lobster subsection of the Affected Environment. Given these preferred habitats, they are less likely to be found in the dredge project area and consequently, no significant impact to the younger stages of the lobsters is anticipated as a result of project operations. The larger juveniles, and adult lobsters could be present in the areas of ledge removal. However, they are expected to have the ability to move away from project activities associated with rock removal (drilling and setting the charges) operations. Since lobsters do not have a swim bladder they should be resistant to the effects of any blasting activity (Keevin and Hampen, 1997), unless in they are in the immediate vicinity of the blast.

Lobster investigations were conducted during the BHNIP to address concerns that the fishery was being impacted by the dredging operations. In response to this concern, the MA DMF increased the number of MA DMF observers on lobster trips and additional efforts were made to assess and document catches/landings in the Reserved Channel by the Independent

Observer hired for the BHNIP (ENSR, 2002). Dredged material was screened in the barges for lobster and an underwater video was used to survey areas to be dredged. The results of these surveys showed juvenile lobsters in the project area, but not in large numbers. In addition, no lobsters were observed during any of the dredging oversight or on screened material (ENSR, 2002).

It is assumed that some ovigerous (egg bearing) females are likely to remain in Boston Harbor, spawning early, and brooding and hatching their eggs annually within the harbor (see Subsection of the 3.4 Biological Environment). If the females remain resident in the area throughout the year, they are likely to remain within their shelters and move little during the winter months. As a result, any physical disruption of their habitat in winter months could directly impact these individuals and their brooding embryos due to their reduced ability to move quickly during cold temperatures. Lobsterman fish within the Boston navigation channel year round, indicating that at least some of the lobsters are mobile within the channel areas during the winter months. It is unknown what percentage of this mobile population are ovigerous females. Consequently, there may be some direct impact to these individuals. However, dredging operations would only impact a small area at any one time allowing the lobsters capable of moving to leave the area of disturbance.

To reduce potential impacts to ovigerous females that are less mobile in the colder months, no dredging will occur below the Third Harbor Tunnel between December 1 and March 31. Surveys submitted by the lobstermen indicate that most of the lobster fishing activity occurs below the Third Harbor Tunnel. It is assumed that this may be an indication of the relative abundance of lobster in the Boston Harbor project area. Although fishing in the navigation channel is prohibited, the lobstermen will be notified prior to movement of the dredge to relocate their pots so they will not be impacted by dredging activities. A similar notification process was employed for BHNIP and the OHMDP to minimize impacts to lobster gear by the dredging operation.

Blasting Impacts

Blasting of rock will occur in the Main Ship Channel between the 35 and 40-foot channels (approximately 200 cy in area of unsuitable material) as well as in six areas within the President Roads Anchorage (1,800 cy in area of suitable material). Blasting the rock in the navigation channel will have an impact on any benthic organisms, lobsters, and finfish with air bladders in the vicinity of the operation. The excavated rock in areas of suitable material will be deposited in a dedicated area at the Massachusetts Bay Disposal Site (MBDS) to provide additional habitat structure for organisms at the MBDS. Rock removed from any area with unsuitable material would be disposed of within a CAD cell.

As noted above, blasting operations in an estuarine environment can injure and/or kill fish and other marine life. Underwater shock waves from high-velocity explosives have been reported to result in the rupture of the swim bladder and other internal organs of fish. The degree of impact experienced by fish is related to the species, size, life stage of the animal, water depth, the weight of the explosive charge, and the distance of the fish from the charge (Wright, 1982). Fish with swim bladders and smaller fish have been found to be more susceptible to damage from shock waves than non-swim bladder fish and larger sized fish (Wright, 1982; Keevin and

Hampen, 1997). Fish eggs and larvae may also be killed or damaged by an explosion. Most benthic marine organisms are highly resistant to explosive shock (Keevin and Hampen, 1997).

As part of the Boston Central Artery/Tunnel Project, an Electronic Fish Startle System was used prior to blasting, and monitoring of dead, stunned, or disoriented fish occurred after the blast during the herring run. Eighty-seven production blasts were monitored and during 62 blasts no dead fish were observed (Firstenberg, 1993). For those blasts involved with a fish kill, fewer than six herring were usually killed during a single blast. The 1990 underwater blasting for the Portsmouth Harbor and Piscataqua River Navigation Improvement Project resulted in no fish being killed in approximately two-thirds of the blasts. A pre-blast charge set to scare fish away from the area made no significant difference when a fish kill occurred (Corps, 1990). Monitoring and fish deterrence methods have improved, but there is always the potential for some fish, especially those with a swim bladder to be impacted by an underwater blast.

No blasting was required during the main portion of Phase 2 of the BHNIP. However, a limited amount of blasting was performed in the upper portion of the Chelsea River in August 2001. No fisheries impacts were observed (ENSR, 2002).

To reduce the impact to biological resources from blasting, all blasting will be conducted using inserted delays of a fraction of a second per hole. Rock or similar material will be placed into the top of the borehole to deaden the shock wave reaching the water column (a process referred to as stemming). A fisheries and mammal observer, and fish detecting sonar system, will be used to avoid blasting events when mammals are present in the area or when significant schools of fish are observed using sonar or other means to detect schools of fish.

Winter flounder are demersal fish and are not usually found in areas with hard substrates, where blasting would occur. In addition, they do not have a swim bladder so little if any impact to this species from blasting is expected. The eggs and larvae are found in shallow depths so any turbidity plume in the channel should not cover the entire width of the river, nor cover winter flounder spawning habitat.

To reduce potential impacts to ovigerous lobsters that are less mobile in the colder months, no blasting will occur seaward of the Third Harbor Tunnel between December 1 and March 31.

Marine and Coastal Birds

The effects of dredging on marine and coastal birds in the Federal channel would be minimal. Most of the species of birds identified in the Marine and Coastal Birds Section and Appendix B may be found in various areas of Boston Harbor and Massachusetts Bay, depending on the season and species-specific foraging habits. Many of these bird species have large foraging and migrating ranges; therefore, the chances of dredging and disposal events having an adverse effect on a particular species' population in these areas are small. Most birds in the Boston Harbor area would use the shallow and intertidal habitats and not the channel areas where dredging and disposal operations would occur. The operation of the dredge in the channel would likely cause most birds to avoid or leave the immediate project area(s). The food value for any waterfowl, especially diving birds in the area is limited by depth. Dredging may temporarily decrease the prey availability for some species; however, impacts would be minimal given the overall project footprint relative to other potential feeding areas within the harbor.

Marine Mammals and Reptiles

The use of Boston Harbor by whales, dolphins, seals, or sea turtles is possible but unlikely. The potential for finding any of these species does increase at the MBDS and the areas used to travel through to get to the disposal site. All of the sea turtle and most of the whale species that have any potential of being in Boston Harbor and Massachusetts Bay are endangered species and discussed in the Threatened and Endangered Section in the Affected Environment. The harbor seal, harbor porpoise, gray seal, white-sided dolphin, and minke whale all have the potential to be present in some area of the project operations. The white-sided dolphin has the least potential to be impacted by the dredging and disposal operations since they tend to be found further out on the continental shelf. Minke whales are found in Massachusetts Bay and while none have been recorded at the MBDS they have been identified in surrounding areas (Short and Schaub, 2005). The harbor seal, harbor porpoise, and gray seal have the potential to be found at both the dredge areas and along the path to the disposal area, but if any wander into the harbor during dredging activities their mobility will allow them to avoid impact. Therefore, no significant impacts to any of these species are expected as a result of dredging or disposal activities. A marine mammal observer will be on board to confirm that no marine mammals are present prior to any blasting activity.

CAD Cell Construction and Disposal Operation Impacts

Excavation of the CAD cells would directly impact any organisms living in the footprint area and organisms in the adjacent areas (i.e. the surrounding environment) have the potential to be indirectly affected through sedimentation and increased turbidities similar to the dredging of the navigation channel discussed in the previous section. As stated in the Benthic Environment subsections above, the quality of the existing benthic community in Boston Harbor is stressed and degraded as a result of the current habitat conditions.

Monitoring of previous disposal events in Boston Harbor CAD cells as well as those constructed as part of the Providence River and Harbor Maintenance Dredging Project showed that sediments typically stayed within the CAD cell boundaries after disposal (ENSR, 2002). Therefore, there should be limited impacts to the areas surrounding the CAD cells. Since the majority of unsuitable sediments will be placed into one large CAD cell, impacts will be limited to this area during the course of the project. Once the CAD cell is constructed, disposal events would prevent the establishment of a pioneering benthic community until the project is completed.

A review and summary of historic monitoring data at the CAD cells constructed as a part of the BHNIP follows.

One Year Investigation

Investigations conducted of the Boston Harbor CAD cells one year after disposal operations had ceased showed that benthic organisms recolonized the sediments within the cells. Stage I pioneering species of polychaetes, as well as various small bivalve and gastropod mollusks were present establishing a community structure similar to the surrounding harbor bottom (SAIC, 2001). Even the Chelsea River CAD cell, which was not capped, showed a stable pioneering benthic community (Stage I) with some stage III organisms (infaunal deposit feeders) after only nine months.

The benthic community assessment data collected over the CAD cells and reference areas as part of the summer of 2001 survey is comparable to the results obtained from similar efforts performed in Boston Harbor prior to the Boston Harbor navigation improvement project. The seafloor within this industrial harbor is subject to a significant amount of organic loading and benthic disturbance associated with vessel activity. As a result, the surface of the Boston Harbor CAD cells will likely require about a year to return to pre-dredge conditions.

Two years after capping the Mystic River CAD cells, macrofauna including finfish, crabs, and lobsters as well as tube dwelling polychaetes were found within the cells (SAIC, 2003). The presence of lobster fishing gear was also found within the area; together this information suggests that the CAD cell areas may be relatively productive and offer a source of forage for these larger invertebrates. Since the sand cap covering the unsuitable material within the Mystic River CAD cells is a different sediment type than surrounding environment (sand versus silt), it is possible that the benthic community structure (colonization) may change over the long term as fine silty sediments from the surrounding area settle in the CAD cells overlaying the sand cap.

The 2001 monitoring survey conducted by SAIC (SAIC, 2001) at the Inner Confluence CAD site was performed four years after disposal operations had ceased. The monitoring results for this CAD cell showed a more stable benthic infaunal community compared to the other CAD cells as well as nearby reference areas, with relatively deep RPDs (redox potential discontinuity) and a higher level of Stage II and Stage III organisms. Overall, SAIC (2001) found sampling of the dredge areas of the Inner Confluence, Mystic and Chelsea River to be consistent with conditions observed prior to the BHNIP. Similar recoveries are expected after completion of this dredging project.

Five Year Investigation

A five-year assessment of the nine BHNIP CAD cells was performed in 2004 as required for the WQC (ENSR *et al.,* 2005). Multibeam bathymetry, sediment profile imaging (SPI), side scan, and videos were taken to determine the status of the CAD cells. The completed CAD cells varied in age from four to seven years. The investigation was designed to: 1) assess the general physical status of the surface of each CAD cell to evaluate cell stability, with a more detailed assessment of one cell (M19) where a linear depression in the capped surface of cell had been identified in 2002; and 2) assess the benthic recoloniziation status of each of the nine CAD cells.

The high resolution multibeam bathymetry and side scan sonar data collected as part of the August 2004 survey revealed that all nine CAD cells remained as stable structures with no evidence of significant cap disturbance or scour. As expected, limited further consolidation of the material within the cells had taken place, and some sloughing of the exposed sidewalls of the cells that rise steeply above the cell surface had also occurred. Both of these processes are expected to continue into the future, but without effect on the overall structure or integrity of the cells. The linear depression previously identified over cell M19 was clearly visible in 2004. Review of the bathymetry of cell M19 prior to disposal revealed a similar feature on the bottom of the cell. It is believed that the surface depression was the result of consolidation of material within the cell causing the surface topography to follow that of the underlying cell floor. The depression appeared stable over time.

While many of the cells had capping sand exposed at the surface at the completion of the project, silt-clay was identified as the predominant surficial sediment in 2004 (based on SPI, video, and side scan). This shift was expected as the cells, depressed below the surrounding bottom, receive sediments transported in runoff or resuspended from other areas of the harbor. Accretion of material within the cells was not identified in comparing the 2004 bathymetry data with data collected two to seven years prior. This would indicate that the depositional rate within the cells was relatively small and/or continuing consolidation of the dredged material with the cells masked the deposition. Large scale debris (tires, piles, timbers, etc.) was also identified on the surface of some of the cells in 2004. Deposition of fine material (as well as larger debris) is expected to continue into the future, helping to further sequester the material deeper within the cell.

The towed video footage collected in 2004 revealed numerous small fish and crustaceans at the bottom of both the CAD cells and reference areas. However, based on sediment-profile images taken in 2004, the general benthic habitat conditions observed within the cells and reference areas were indicative of a stressed environment. The continual exposure to stressful conditions limited the recolonization and successional status of both the CAD cells and associated reference areas, resulting in an environment in a perpetual state of early succession. This was expected given the periodic episodes of poor water quality and physical disturbance associated with a working harbor environment.

The CAD cells have performed as expected and meet the requirements of the WQC by demonstrating the integrity and thickness of the cap material.

Mitigation for Dredging and Disposal in Boston Harbor

As a result of the extensive monitoring executed for the BHNIP, and the lack of any water quality violations or significant impacts, only confirmatory water quality monitoring during disposal operations is recommended for the IHMDP. It is recommended that total suspended solids and turbidity monitoring would be performed during the first time disposal occurs into the Mystic River CAD cell and into the Main Ship Channel CAD cell.

To reduce potential impacts to resources in the project area, based on lessons learned, the following mitigation measures will be implemented:

- An enclosed "environmental" bucket will be used for silt dredging.
- To reduce the effects of turbidity on water quality, no overflow from the scows will be allowed.
- Disposal into the CAD cells will occur only around periods of slack tide: three hours each at low tide and high tide (one hour before and two hours after slack tide).
- A three-foot sand cap will be placed in the CAD cells when the silt has consolidated enough to support a cap. The cap material will be released from a moving, not stationary platform. No spudding over the cap or mechanical disturbance of the cap will be allowed.
- To reduce the impact to biological resources from blasting, all blasting will be conducted using inserted delays of a fraction of a second per hole. Rock or similar material will be placed into the top of the borehole to deaden the shock wave reaching the water column. A fisheries and mammal observer, and fish detecting sonar system, will be used to avoid blasting when mammals are present in the area or when significant schools of fish are observed.
- A fisheries observer, sonar detection, and a startle system from February 15 to June 15 will be required for the Mystic River and Main Ship Channel CAD disposal activities to avoid disposal during the presence of anadromous fish migration.
- To reduce potential impacts to ovigerous lobsters that are less mobile in the colder months, no dredging or blasting will occur seaward of the Third Harbor Tunnel between December 1 and March 31.
- The dredge contractor will provide advance notice to the lobstermen on anticipated dredging locations and movements.

Based on incorporation of the above mitigation measures, the experience gained during construction of the BHNIP, and lack of any water quality violations or other significant effects from the BHNIP, no significant impacts to the environment are expected from the IHMDP.

4.3 Disposal Impacts at the Massachusetts Bay Disposal Site (MBDS)

Physical Impacts

Dredged material is released from scows operating on the surface and passes through several phases as it travels to the seafloor at the Massachusetts Bay Disposal Site. Several factors influence the behavior of the descending plume, including the properties of the sediment (e.g., silt, sand, clumps, etc.), water depth, water column stratification, and the interplay of the descending sediment with the water through which it passes. In general, the behavior of the plume can be described as occurring in three phases: convective descent, dynamic collapse, and passive diffusion. The three phases are discussed in more detail below.

- **Convective descent -**The first phase of plume following release of the dredged material from the barge into the water column is the convective descent. This phase begins with the release of the material from the transport device (disposal scow). During this phase, the material descends through the water column under the influence of gravity, generally maintaining its identity as a single mass (Brandsma and Divoky, 1976). During its descent, the area occupied by the plume expands as the local water is entrained into the descending cloud of dredged material. Kraus (1991) found that plumes resulting from the disposal of up to 5,000 cy of sediment (most scows fall in this range of size) in waters up to 65 feet deep spread 300 to 600 feet during the convective descent phase. In addition, the suspended sediment concentration was reduced by turbulence and dilution with the surrounding water mass. The duration of this phase depends on the depth of water, lasting from seconds in relatively shallow areas to minutes in waters over 984 feet. Field and laboratory studies indicate that approximately 1 to 5 percent of the sediment discharged from a barge remains in the water column following the convective descent phase (Ruggaber and Adams, 2000a; Ruggaber and Adams, 2000b; Tavolaro, 1984; Corps, 1986).

- **Dynamic Collapse –** This phase occurs when the descending plume impacts the bottom or reaches a neutrally buoyant position in the water column and diffuses horizontally under its own momentum. In areas with strong stratified water columns, particularly in water columns of several thousand feet, this process is complicated because portions of the plume may attain neutral buoyancy before hitting the seafloor. In those situations, a portion of the descending mass loses its downward momentum and comes to reside as a plume at its neutrally buoyant depth. The plume can oscillate around the depth of neutral buoyancy, creating a vertical oscillation of material. The residence of the materials within such an oscillation results in increased turbulence in the water column and increases the speed with which the plume dilutes and spreads horizontally as it comes into hydrostatic equilibrium. Studies have shown that this condition does not occur in water less than 262 feet. This is because the sediment impacts the bottom regardless of the water stratification. This is due to the fact that the initial momentum and specific gravity are too great to be overcome by plume buoyancy. Depending on water depth, dredged materials may have sufficient momentum to travel laterally for hundreds of feet upon impacting the bottom.

- **Passive diffusion -** Passive diffusion refers to the transport and dispersion of the disposed material by the ambient oceanographic conditions (currents and turbulence) rather than the hydrodynamics occurring during the descent of the plume body. This phase results in the dispersion and transport of the suspended sediments and may last for several hours. Numerous field studies have confirmed that plumes are transient features of dredged material disposal from barges (Dragos and Lewis, 1993; Dragos and Peven, 1994; SAIC, 1988).

- **Verification of Dredged Material Disposal Plume Dynamic –** During the disposal operation, a portion of the dredged material released (generally a fraction of any fine silt and clay particles present) may remain in the water column as a turbid plume for several hours, where it will drift with the current. Dredged material plume dynamics for offshore operations have been verified at several sites in New England and in other locations in the United States. For example:

- 500 to 5,000 cy of dredged material released in shallow depths of 50 to 66 feet in the Gulf of Mexico (Krause, 1991) had an associated plume spread (widening) of 110 to 220 yards during the convective descent phase.

- Increased turbidity from the plumes in the water column has been documented for up to two hours after disposal of 4,000 to 6,000 cy of dredged material in the New York Bight (water depth approximately 92 feet) (Dragos and Lewis, 1993; Dragos and Peven, 1994). Dilution of the dredged material within 2 ½ hours of disposal had achieved ratios of 3,000:1 to 600,000:1 (based on total suspended solids (TSS) analyses of water samples). Observed plume spreading at the time was generally less than 550 yards, and local currents carried the plumes up to about 0.6 mile from the discharge point, which was consistent with the current velocities at the time of the survey. Turbidity profiles collected throughout the disposal site and surrounding areas before and after disposal events did not find elevated turbidity in the vicinity of the disposal site that could be attributed to dredged material disposal (Dragos and Lewis, 1993; Dragos and Peven, 1994).

- Plume transport at the Rockland Disposal Site in Maine was limited to approximately 500 yards from the point of discharge for a 1,900 cy disposal event (SAIC, 1988). However, the plume from a larger barge volume (3,640 cy) was transported approximately 1 mile from the disposal point over a two hour period, with suspended solids concentrations decreasing by 99 percent of those initially measured (~1,500 mg/L, decreasing to 14 mg/L).

- Studies at the Massachusetts Institute of Technology (MIT) (Ruggaber and Adams, 2000a; Ruggaber and Adams, 2000b) used "flow visualization" devices in a laboratory setting to confirm that a small percentage of sediment remains in the water column after a disposal event. This laboratory study evaluated how plumes form and how sediment particle characteristics affect the plume formation. The study was also designed to determine how much material is incorporated into the descending cloud and how much is lost during convective descent. The study estimated that less than one percent of the original mass exiting the barge separates from the material contained within the collapse phase during the discharge and remains in the water column. This is consistent with the lower range reported from field studies (Tavolaro, 1984; Corps, 1986).

These studies show that only a small amount of sediment remains in the water column after a disposal event and that, in general, the material is rapidly diluted and dispersed and is not discernible after two to three hours. The concern about the small amount of material that remains in the water column pertains to potential impacts from (1) reduced light penetration induced by the residual sediment in the water column, which may reduce photosynthesis, and (2) the possible release of nutrients or contaminants from the sediments during the descent phase. Reduction in light penetration is usually short in duration (on the order of hours). Studies of the nutrient and other contaminant releases from the descending dredged materials show that the release is limited with no toxicity to sensitive marine organisms as determined through biotoxicity testing. The incremental addition of nutrients or contaminants from dredged material disposal, relative to other sources such as rivers, wastewater treatment facilities and nonpoint sources is small and inseparable from ambient conditions (Corps, 1982). The intermittent nature of the disposal operations, the short time period that material stays in the water column (usually less than two to three hours), along with rapid dilution and settling further limit any potential effects.

Topographic change occurs within an open water dredged material disposal site over the course of the site's history. Initially, the disposed material creates a mound, changing the local topography. Mound building may be intermittent or continuous, depending on dredging cycles and projects. Final site topography depends on site management practices. Several long-term processes can reduce mound height or modify the mound topography after disposal is complete. These include physical and biological processes that act to "smooth" the roughness of the mound (Rhoads, 1994). Also, newly deposited dredged material compacts under its own weight and often deforms the seafloor beneath it. Both actions reduce the mound height. Bottom currents winnow, transport, and redistribute materials from the mound surface. The amount of transport and redistribution depends on the sediment texture (grain size), sediment cohesiveness, and current strength. Biological processes such as colonization (including burrowing) and foraging by megafauna also act to smooth the mound's surface, modify its response to erosion forces, and change its topography. These physical and biological processes may also modify the nature of the surface sediments on the mound over time. Many studies have demonstrated that the upper inch or two of dredged material mounds can be winnowed of fine-grained sediments, leaving behind coarse sediments that are more resistant to erosion. Such winnowing eventually reaches an equilibrium distribution that reflects the critical erosion velocity at the site.

The location of the Massachusetts Bay Disposal Site (MBDS) in a deep water basin (almost 300 feet deep), protects the site from the effects of major storms. Studies from the Disposal Area Monitoring System (DAMOS) program have shown that the material disposed at the MBDS forms a distinct mound. Several disposal mounds have been formed within the boundaries of the MBDS. MBDS had been subject to at least two major storms, Hurricane Bob in 1991 and the Halloween Storm also in 1991. Monitoring surveys were conducted at the MBDS in 1990 and 1992 (pre- and post-storm) as part of the DAMOS. Surveying and monitoring were conducted with precision bathymetry and REMOTS® sediment profile photography. Previous bathymetric/REMOTS monitoring surveys at MBDS occurred in August 1990. Since 1990, initiation of a major construction project in the Boston area, the Central Artery/Third Harbor Tunnel project, resulted in increased disposal activity at the site. One of the objectives of the 1992 DAMOS field work was to map the distribution and thickness of dredged materials that MBDS received following the 1990 survey.

It was predicted that the dredged materials disposed since 1990 would have increased the size of the mound detected by bathymetry in 1990. The precision bathymetric survey detected the maximum thickness of the disposal mound approximately 300 feet west of the buoy, which is the location of the active disposal. Dredged material detected by the 1992 REMOTS® survey extended approximately 1,968 feet east, 1,312 feet south, 2,625 feet west, and 1,312 feet north of the buoy location. The results of the survey showed there to be no substantial resuspension or transport of dredged material as a result of Hurricane Bob and the Halloween Storm.

Sediments in the area of the MBDS are composed predominantly of fine-grained silts and clays. The dredged sediments are silt and clays with some sand and gravel that is considered to be suitable for unconfined open water disposal. Only material that found suitable for ocean water disposal after testing will be disposed at the MBDS. However, DAMOS studies indicate levels of metals and organics in the dredged material within the disposal site can be above background levels, indicative of the industrial nature of the areas dredged that utilize the site. On average, approximately 300,000 cy of dredged material a year has been disposed at the MBDS from previous Boston Harbor dredging projects and other harbors in the region. As our waterways become cleaner (i.e. Boston Harbor), material disposed at the MBDS has not and is not expected to significantly change the present character of the disposal site in Massachusetts Bay.

Chemical Impacts

Prior to disposal of material at the MBDS, required testing to satisfy Marine Protection, Research and Sanctuaries Act (MPRSA) criteria was conducted and the material found to be suitable for disposal. STFATE modeling will be conducted to confirm no impacts to the water quality would occur outside the disposal site from disposal of the parent material/and suitable silty maintenance material.

Biological Impacts

The MBDS was last monitored for benthic recovery in the fall of 2000 (SAIC, 2002), after most of the Boston Harbor navigation improvement project was completed. Most of the material disposed at the MBDS was Boston blue clay, similar to the material to be disposed from the IHMDP (and the silty maintenance material). Remote Ecological Monitoring of the Seafloor (REMOTS®) surveys were employed to monitor the recolonization of the disposal mound after disposal. The fall 2000 REMOTS® sediment-profile images examined the surface sediment composition and evaluated the benthic recolonization status over each disposal mound. The images confirmed the presence of the deposited Boston blue clay. Past environmental monitoring surveys at subaqueous dredged material disposal sites have shown that sediments of a glaciomarine origin (i.e., Boston blue clay) tend to be very cohesive and devoid of organic matter. Although a firm substrate is ideal for surface dwelling, Stage I benthic infauna and epifauna, this type of material can impede the development of a stable Stage III (burrowing and deposit feeding) population. As a result, dredged material mounds showing a high percentage of glacial clay in the surficial layers often display a slower rate of benthic recolonization relative to marine sediment deposits.

As expected, the disposal mounds displayed a benthic infaunal community composed primarily of Stage I pioneering polychaetes with some occurrence of Stage III head-down deposit feeders. The older mounds exhibited a higher occurrence of Stage III activity. However, the benthic community appeared to be recovering on the newer mounds as anticipated, although at a lower community status than the surrounding reference areas. The benthic habitat conditions over the disposal mounds are expected to continue to recover over the next several years, as Stage III activity becomes more widespread and the redox potential discontinuity (RPD) depths deepen as the glacial clay is biologically reworked and additional silts are incorporated through natural deposition. Any benthic organisms inhabiting the disposal area would be buried during disposal events. However, once disposal ceases, recolonization of the mound would begin.

Marine and Coastal Birds

Pelagic birds and waterfowl are more common in the open waters of Massachusetts Bay and would likely be the only species that could potentially be impacted by disposal activities at the MBDS. These birds spend most if not all of their time on the water or foraging in the water for fish, crustaceans, or invertebrates.

Birds in the area of a disposal site would most likely avoid the immediate vicinity during disposal operations. Birds resting on the water or foraging in the area would likely leave during disposal activities and would not be impacted. Some species, such as gulls, would be attracted to disposal operations to forage but they are not expected to be negatively impacted by disposal activities.

Marine Mammals and Reptiles

See Section 4.4.

Mitigation for Disposal at MBDS

The following mitigation steps will be taken to reduce biological impacts and to enhance habitat at the MBDS.

- A marine mammal observer will be on board the scows transiting to the MBDS from February 1 to May 31 to avoid potential ship strikes with marine mammals, and in particular the North Atlantic Right Whale.

- Rock removed from the project area will be placed within a new area of the MBDS to increase habitat diversity.

4.4 Endangered, Threatened and Species of Special Concern

According to correspondence from NOAA Fisheries (July 21, 2005) there have been no surveys for sea turtles in Boston Harbor, but suitable forage and habitat exist in the area and it is likely that sea turtles occasionally are present in Boston Harbor. However, no direct impacts to sea turtles are likely from project operations given the low likelihood of their occurrence within the immediate area and because any sea turtles that may be present during dredging operations should be able to avoid the mechanical dredge. Any indirect impacts to sea turtles that may occasionally transit the area, such as impacts to forage items, are expected to be minimal since they are mobile and suitable foraging areas occur elsewhere in the vicinity of the project.

Whales are not likely to occur in Boston Harbor; therefore, it is highly unlikely that they will be affected by the proposed dredging activities.

Sea turtles and/or whales may be encountered by tugs and scows transiting to the MBDS. Consequently, NOAA Fisheries and the Corps and have agreed to conditions to reduce the potential for vessel collisions with endangered species. From February 1 through May 31 of any year, disposal vessel including tugs, barges, and scows transiting between the dredge site and the MBDS will operate at speeds not to exceed five knots after sunset, before sunrise, or in daylight conditions. From February 1 through May 31 of any year, an approved marine mammal observer will be present aboard disposal vessels transiting between the dredge site and the MBDS during daylight hours. To date, the marine mammal observation reports from previous disposal operations have not indicated any physical contact with whales while transiting to MBDS. The Massachusetts Water Resources Authority has conducted monitoring surveys that have included marine mammal observers as part of the Harbor and Outfall Monitoring Project since 1995. Since 1998 no endangered species have been identified in the MBDS area, but in 2004 two finback whales were identified from an area slightly south of the disposal site (Short and Schaub, 2005).

Correspondence dated September 16, 2005 received from the Massachusetts Natural Heritage and Endangered Species Program (NHESP) states that there are no state-listed rare animals in the immediate vicinity of the project site.

4.5 Historical and Archaeological Impacts

The Corps has conducted remote sensing and underwater archaeological investigations in the Boston Harbor area for previous dredging activities. In 2003, as part of our compliance responsibilities for the Boston Harbor Deep Draft Navigation Improvement Study, a remote sensing archaeological survey of the Boston Harbor shipping channel was conducted by University of Massachusetts Archaeological Services (UMAS) (Mulholland *et al*., 2003). Utilizing site location characteristics, sea level curves, and reconstructed past landforms, the study found that there was a potential for inundated Native American sites to be located within portions of the project area. Subsurface testing through the use of vibratory cores was recommended. The historic period background indicated that at least 93 vessels were lost in the general area of the harbor channel, but none were known to be specifically within the study area. Analysis of the remote sensing data produced 187 targets that required further consideration;

however, only 3 appeared to be potentially significant historic shipwrecks. Dive investigations were recommended for these 3 targets. In addition, one sunken barge was located in two sections in the outer (east) entrance to the North Channel. This barge was removed during the maintenance dredging in 2004-2005.

In September 2003, the Public Archaeology Laboratory, Inc. (PAL) conducted an inspection of magnetic anomalies surveys to determine the nature of the three anomalies identified during the UMASS study (Robinson and Ford 2003). Due to the depth of the channel, the survey was conducted with the use of a remotely operated vehicle (ROV). The systematic and visual ROV survey consisted of 21 survey lines spaced at 10-foot intervals, with the collection of visual and magnetic data along each line. Limited excavation using the ROV thruster-wash deflector was also conducted at the locations of the three magnetic anomalies.

No pre-Contact Period cultural materials or archaeological features were identified during the 2003 ROV survey. The only cultural resources noted were lobster pots and modern debris. Lobster pots and/or magnetic rock outcrops or boulders likely caused the magnetic anomalies. Additionally, archaeological subsurface testing through the use of nine vibratory cores was completed in September 2003 by UMASS (Lynch *et al*., 2004). Testing was concentrated within three separate areas: the north channel; the western portion of the project area including the Reserved Channel and Mystic River confluence; and the Mystic River area. Cores were collected and then analyzed for stratigraphic integrity and evidence of inundated archaeological resources. Both visual means and magnetic susceptibility techniques were used to attempt to detect buried soil horizons. Likely sediments were also screened for artifacts. Profiles of visible stratigraphy were recorded and the magnetic susceptibility was plotted and graphically reproduced. The magnetic susceptibility graphs reliably detected changes in stratigraphy. For the Boston Harbor channel area, potentially preserved cultural resources are well below the maximum depth of proposed dredging. Preserved sites, if they exist, will not be impacted by the dredging. No further survey was recommended.

As a result of the preceding investigations, no significant resources were expected during the Boston Harbor Deep Draft Navigation Improvement Study. The remains of the sunken barge were that of a modern 20th century steel vessel and were not considered historically significant. Coordination with the Massachusetts State Historic Preservation Officer (MA SHPO), the MA Board of Underwater Archaeological Resources (MA BUAR) and the Naval Historical Center (pertaining to the sunken barge only) ensued and resulted in concurrence with this determination. No further investigations were required.

This Supplemental EIS addresses proposed inner harbor maintenance dredging to restore the authorized project dimensions. Dredging will be confined to previously disturbed contexts and impacts to significant resources are not expected. Additionally, the creation of CAD cells within the channel, for disposal of unsuitable material, will not affect cultural resources due to the extensive modifications of the shipping channel and prior dredging. Suitable material from the dredging will be deposited at the MBDS, a previously utilized disposal area for prior dredging activities. Therefore, the Boston Harbor Inner Harbor Maintenance Dredging Project should have no effect upon any significant site or structure of historic, archaeological, or architectural significance as defined by the National Historic Preservation Act of 1966, as amended, and implementing regulations 36 CFR 800. The MA BUAR, by letter dated June 21, 2005 and in response to the Corps Public Notice of the Inner Harbor Maintenance Dredging

Project, has concurred with this determination. We expect the MA SHPO to concur with this determination as well.

4.6 Social and Economic Impacts

Boston Harbor is an active harbor with many users. These users include recreational, shipping, and fishing interests. Without a well maintained harbor, goods can not be shipped as efficiently and jobs associated with this industry, both directly and indirectly, are affected. Dredging and disposal would have minimal impacts on recreational boating and vessel passage because the dredge contractor must allow free navigation at all times. Dredging will have a long-term benefit on recreation or tourism dependent on navigational access.

At least 16 lobstermen fish in the project area at any one time, based on the survey information received. See lobster Subsection of 3.4 above. Most of the lobstermen fish in the area between the Ted Williams Tunnel and Spectacle Island and most of the fishing activity occurs during the summer and early fall months. Although fishing is prohibited within the Federal navigation channels, to minimize impacts to the lobster industry in Boston Harbor, the dredge contractor will provide the lobstermen a weekly schedule of dredging activity and 24-hour notice if the schedule differs than predicted.

No significant adverse environmental impacts to children, minority or low income populations are anticipated as a result of this project. According to the 2000 U.S. Census Bureau, the population of Suffolk County, which includes the cities and towns surrounding Boston Harbor, is comprised of about 58% white people. Nineteen percent of the individuals are below poverty limit. Although the project area has a larger percentage of minorities and low-income population compared to the rest of the Commonwealth of Massachusetts, this dredging and disposal project is not expected to have a significant human health or environmental effect on any portion of the human population. Extensive environmental monitoring for the BHNIP did not reveal any water quality violations.

4.7 Cumulative Impacts

The National Environmental Policy Act (NEPA) defines cumulative effects as: "the impact on the environment which results from the incremental impact of the action ((i.e., Boston Harbor Inner Harbor Maintenance Dredging) when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7).

Cumulative effects analysis is an emerging discipline, and the continuing challenge of this analysis is to focus on the important cumulative issues, recognizing that a better decision, rather than a perfect cumulative effects analysis, is the goal of NEPA. Determining the threshold beyond which cumulative effects significantly degrade a resource, ecosystem, and human community is often problematic, as no definitive thresholds for cumulative analysis exist. Ultimately, however, cumulative effects analysis under NEPA should be incorporated into the agency's overall environmental planning and the regional planning of other Federal agencies and stakeholders (CEQ 1997). Similarly, the MEPA regulations also require discussion of cumulative impacts of the project.

The cumulative impacts assessment that follows considers a project area including both Boston Inner and Outer Harbors (See Figure 2-2). Projects within this area that have been constructed since the BHNIP (approximately five years ago) and those identified through the foreseeable future are included within this cumulative impact assessment. Potential future projects within this geographic area include those on file with MEPA at this time of this SEIS/NPC.

4.7.1 Boston Harbor Dredging Projects

Boston Harbor Navigation Improvement Project (BHNIP)

The BHNIP consisted of maintenance and improvement dredging in a portion of the channels and berths within Boston's Inner Harbor. The Mystic River, Inner Confluence, and Reserved Federal navigation channels were deepened from –35 feet MLLW to –40 feet MLLW. The Chelsea River was deepened from –35 feet MLLW to –38 feet MLLW. A number of berths were also deepened to various depths.

Phase 1 consisted of dredging Conley Terminal Berths 11 and 12 to –45 feet MLLW and disposing of the material into a CAD cell located in the Inner Confluence in the summer of 1997. Phase 2 included dredging the remainder of the area with disposal into eight CAD cells between August 1998 and September 2000, with some additional work completed by December 2001.

Approximately one million cy of silty maintenance material, one million cy of improvement material (also referred to as parent material), and an additional 1.4 million cy of parent material was removed in the construction of the CAD cells, for a total of 3.4 million cy of dredged material. The maintenance material was disposed into CAD cells located within the Mystic River, Inner Confluence and Chelsea River and capped with three feet of sand, except the Chelsea River CAD cell. The parent material was disposed at the MBDS.

Approximately 56 acres in the Mystic River, 40 acres in the Chelsea River, and 21 acres in the Inner Confluence for a total of 117 acres of temporary subtidal impacts.

Boston Outer Harbor Maintenance Dredging Project (OHMDP)

Maintenance dredging of the outer harbor channels in Boston Harbor occurred from August 2004 through June 2005. Approximately 1.1 million cy of suitable material from the Broad Sound North Channel, President Roads Channel and Anchorage and portions of the Main Ship Channel east of Castle Island was removed to restore this area to its authorized depths. The dredged material was disposed at the MBDS.

Approximately 520 acres of subtidal habitat was temporarily altered by maintenance dredging in the Outer Harbor.

Boston Inner Harbor Maintenance Dredging Project (IHMDP)

Maintenance dredging of the inner harbor channels in Boston Harbor, which is the subject of this SEIS/NPC, is expected to begin the summer of 2006 and continue for approximately two years. Dredging of the silty maintenance material from approximately halfway between Castle Island and Spectacle Island inland towards the Inner Confluence, the upper Reserved Channel and the Navy Dry Dock approach is expected to generate approximately 400,000 cy of maintenance material suitable for open water disposal and 1.3 million cy of material unsuitable for open water disposal. Another 1.5 million cy of parent material will be dredged to construct the CAD cells. The unsuitable material will be disposed in the CAD cells and the suitable material disposed at the MBDS.

Approximately 732 acres of subtidal habitat would be temporarily impacted by constructing this project.

Boston Harbor Deep Draft Navigation Improvement Project

The navigation channels in the outer harbor are being evaluated to determine the feasibility of deepening between –45 feet MLLW and –50 feet MLLW. The areas that could be deepened are the Broad Sound North Channel, the President Roads Anchorage area, the Main Ship Channel, Reserved Channel, a portion of the Mystic River, and the Chelsea River. The unsuitable material would be placed in CAD cells in the Mystic River and the suitable material would be disposed at the MBDS.

If the above navigation channels were deepened to an authorized depth of –45 feet MLLW, then approximately 840 acres of subtidal area would be temporarily impacted by the proposed project. Deepening the channels to –50 feet MLLW would temporarily impact about 1,050 acres of subtidal habitat.

The following section includes a description of other projects that are expected to occur in the project area.

Relationship to Other Projects

Description of Relevant Projects

Projects were reviewed for their nature, location, and time frame of projected environmental impacts in order to determine what, if any, contributing impacts they might have to the anticipated environmental impacts of the proposed project. Projects analyzed in this section are listed in Table 4-1, their locations are illustrated in Figure 4-1.

Table 4-1. Projects Analyzed in the Analysis of Cumulative Impacts

Project	Location	Location	Timeframe
Boston Harbor Islands General Management Plan	Boston Harbor	Boston Harbor Islands	Ongoing
Central Artery	Boston	Spectacle Island Ted Williams Tunnel Fort Point Channel	1995 - 2003
Winthrop Shores Reservation Restoration Program	Winthrop NOMES Site I	Broad Sound	2004 -2005
Fan Pier Development	Boston	Boston Inner Harbor	2000 - 2007
Hubline		Mass. Bay, Boston Harbor - Beverly to Weymouth	2002 - 2004
Pier 4	Boston	Boston Inner Harbor	2003 - 2005
Clippership Wharf	East Boston	Boston Inner Harbor	2004 - 2006
Portside at Pier One	East Boston	Boston Inner Harbor	
Long Island Bridge Abutment Stabilization	Boston	Boston Harbor	2002
Russia Wharf	Boston	Fort Point Channel	2004 - 2007
Yard's End Research Center	Charlestown	Mystic River	2004 - 2006
Marina Bay Maintenance Dredging	Quincy	Dorchester Bay	2004
Sterling Marine Terminal	Boston	Chelsea River	2004 - 2008
Station #385 – Harborwalk and Station	Boston		
Chelsea Sandcatcher Stabilization	Chelsea	Chelsea River	2004
Locke Street Salt Marsh	Chelsea		
Shipyard Quarters Marina Extension	Charlestown	Inner Harbor	2004 - 2005
Pier 5, 8th Street	Charlestown	Inner Harbor	2004 - 2006
Global Petroleum	Revere	Chelsea River	2005
Irving Oil	Revere	Chelsea River	2005
Spectacle Island Maintenance Dredging	Boston	Boston Outer Harbor	2004 - 2005
New South Side Harborwalk	Boston	Inner Harbor	2004 - 2005
Lovejoy Wharf	Boston	Inner Harbor	2006 - 2007
St. Lawrence Cement/Boston Sand & Gravel, Island End River Dredging	Everett	Island End River/ Mystic River	2005
Release Abatement Measure	Everett/Chelsea	Island End River/ Mystic River	2006 - 2007
Old Colony Yacht Club	Boston	Neponset River/ Dorchester Bay	2005
Mill Creek Center	Chelsea	Chelsea River / Mill Creek	2005 - 2006
Boston Children's Museum Expansion	Boston	Fort Point Channel	2006 - 2007

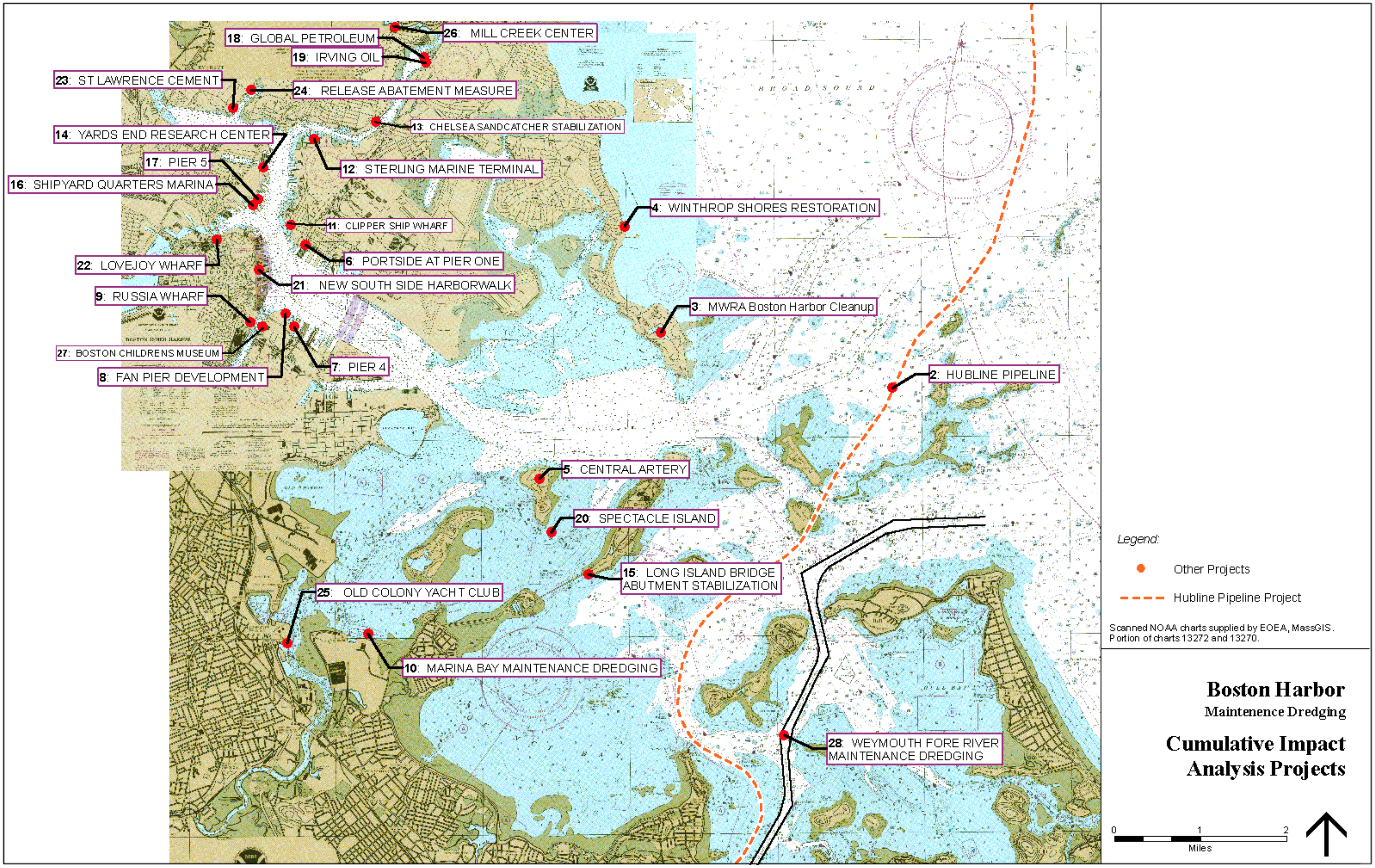


Figure 4 -1. Locations of Cumulative Impact Analysis Projects

Boston Harbor Islands General Management Plan

This is an ongoing effort with multiple activities concerning the long term management of the Boston Harbor Islands park system. Concepts for this management plan include; increased opportunities for visitors to discover the natural and cultural history of the islands, preservation of natural and historical resources, providing visitor programs that focus on cultural and natural history, and promoting use and stewardship of natural and historical resources. No specific construction or program activities are identified that would affect marine resources.

Central Artery

Part of this large project involves the creation of a new 100-acre public park on Spectacle Island in Boston Harbor. The park will have docking access for public ferry and recreational boats, beaches, picnic areas, a trail system, recreation areas, and a visitors' center. During construction of the park, a net total of 6.4 acres of intertidal and subtidal area was permanently filled in order to close the abandoned landfill that existed on the island.
Other Central Artery activities that have impacted marine resources include:

- the Ted Williams Tunnel across Boston Inner Harbor (3,415 square feet of fill – South Boston/BMIP);
- the I-90 immersed tube tunnel across Fort Point Channel (alteration of 2.1 acres of tidal waters) and
- the Zakim/Bunker Hill Bridge across the Charles River and the Millers River (bridge piers – 3,500 square feet in Charles River and 1,500 square feet in Millers River).

Winthrop Shores Reservation Restoration Program

As part of this project, the Department of Conservation and Recreation (formerly the MDC) plans to use an offshore borrow site (NOMES I) for a source of sand for the beach restoration efforts at Winthrop Shores Beaches. The 2002 Draft EIR described improvements to the beaches including the following elements that would affect marine resources:

- placement of beach nourishment fill at Winthrop Beach;
- reconstruction of existing groins, removal of one groin and construction of a new terminal groin at Winthrop Beach; and
- construction of a new storm drainage system.

The Draft EIR did not specify area impacts to marine resources. Other activities would largely be restricted to upland areas at the beach.

Fan Pier Development

This project will redevelop Fan Pier into a multi use area with retail, office, residential, and hotel uses. The project design and composition has changed from the initial proposal, and no complete description of the revised project was available at this writing. A new marina may be constructed as part of the project, initial design included an estimated 9,800 cubic yards of dredging.

Hubline Submarine Natural Gas Pipeline

This project includes the construction of 29.4 miles of submarine high-pressure natural gas pipeline from Beverly to Weymouth and 5.4 miles of pipeline to Deer Island. Portions of the project were constructed in the outer harbor area to the east of the easternmost point of the inner harbor maintenance, no portions of the project were constructed in the inner harbor maintenance dredging project area. The lateral pipeline to Deer Island is the closest portion of the HubLine alignment to the project area. Total impacts to subtidal resources resulting from the entire HubLine project (including the Deer Island Lateral) were estimated at 7,800 acres in the HubLine DEIS (of this total, approximately 7,300 acres were attributable to cable sweep from the pipeline installation activities.) A permanent impact to subtidal areas due to armoring of the alignment was estimated at 3.7 acres.

Pier 4

This project will redevelop Pier 4 into a multi use area with retail, office, residential, and hotel uses. The site is located on the South Boston waterfront at the location currently occupied by Anthony's Pier 4 Restaurant and associated parking. Work will include construction of a below ground parking garage, access ramps, roadways, three buildings, pile supported structures, and accessory structures associated with open space usage. There will also be dredging, seawall stabilization and repair, and minor filling of subtidal areas, although an area is not available from the information on hand.

Clippership Wharf

The proposed project involves development of 400 housing units, 455 parking spaces, commercial and retail space, and associated infrastructure in five buildings on a 12.9-acre site. The purpose of this effort is to activate an underutilized portion of the East Boston waterfront. No impacts to subtidal marine resources are anticipated.

Portside at Pier One

This project involves the redevelopment of Pier 1 into a multi-use area with retail, office and residential spaces, an additional 200-slip marina with rehab of existing 180-slip marina, and rehab of the existing East Boston Shipyard. The renovated property will also include transient dockage, commuter boat layover, and ship berthing. No specific impacts to intertidal or subtidal areas are known.

Long Island Bridge Abutment Stabilization

This project involves the stabilization of bridge abutments on the Long Island Bridge, which links Long Island with the City of Quincy. The abutments to be stabilized are located on the southwest point of Long Island, known as West Head. Minor impacts to subtidal resources may result.

Russia Wharf

This project will refurbish several historic buildings on Atlantic Avenue and Congress Street for mixed use as residences and hotel suites with retail space on the ground floor. It also includes construction of a new 22-story office tower, a 500-space underground parking garage, and a waterfront plaza on Fort Point Channel that will provide a dockage for transient boats. Other than pilings for the transient dock, no permanent impacts to marine resources are anticipated.

Yard's End Research Center

This project will construct two new research buildings, totaling 527,000 square feet of floor space, on 16th Street in the Charlestown Navy Yard. The project will also create three acres of public open space along the waterfront, which will be part of the Boston Harborwalk system. The project is located entirely upland, and no permanent impacts to marine resources are anticipated.

Marina Bay Maintenance Dredging

This maintenance project involves dredging of a 107,800 square foot area, representing less than seven percent of the area of the active boat basin in Marina Bay. No improvement dredging (deepening) is proposed.

Sterling Marine Terminal

The project involves the reconstruction of approximately 300 linear feet of existing bulkhead, construction of a new 50-foot by 60-foot pile-supported transfer bridge, maintenance dredging of approximately 101,000 square feet (2.3 acres), and the construction of two confined aquatic disposal (CAD) cells in East Boston. The dredge material from the proposed project will be disposed of in one of the created CAD cells. A total impact to 128,000 square feet (2.9 acres) is estimated.

Station #385 – Harborwalk and Station

This project includes the construction of a harborwalk along Boston's Reserve Channel, which is designed to provide public access to the waterfront in compliance with City of Boston zoning requirements. This work is for mitigation associated with the expansion of the outdoor electrical switching station #385 in South Boston, which commenced in June 2003 and was authorized under M.G.L. c.91. No permanent impacts to marine resources are anticipated.

Chelsea Sandcatcher Stabilization

This project will remove crumbling portions of an obsolete concrete-and-granite grit collection chamber that extends onto the bank of the Chelsea River. The interior of the chamber will be cleared of debris and filled with concrete. Steel sheeting and stone riprap will be placed along the perimeter of the chamber to stabilize it and blend it into the riverbank, and the deteriorated roof of the chamber will be capped with a layer of concrete. No permanent impacts to subtidal resources are anticipated.

Locke Street Salt Marsh

This project will dredge 1,300 cubic feet of sediment from a 30,000 square foot area of degraded salt marsh along Mill Creek in Chelsea. This dredging will lower the grade by one to two feet in order to permit tidal inundation and create suitable conditions for the reestablishment of salt marsh plants.

Shipyard Quarters Marina Extension

This project will expand the existing marina at Pier 8 in the Charlestown Navy Yard. New piles will be constructed to support 55 new slips, increasing the total capacity from 187 slips to 242 slips, and covering an additional 19,460 square feet of watershed.

Pier 5, 8th Street

This project will construct a new residential complex with 59 units totaling 170,000 square feet on Pier 5 in the Charlestown Navy Yard. The project will also add 1,400 linear feet of public space to the Boston Harborwalk system, and construct a 21-slip marina along the southern end of Pier 5.

Global Petroleum, Chelsea River Dredging

This project will perform maintenance dredging of the existing Global Petroleum marine terminal located in the Chelsea River. Approximately 14,000 cy of marine sediment will be removed from a 2.5-acre area. Sediment will be disposed of in one of the following: a local landfill; a Rhode Island Dredge Disposal Facility; or a CAD cell at the Sterling Marine Terminal site.

Irving Oil, Chelsea River Dredging

This project will perform maintenance dredging of the existing Irving Oil marine terminal located in the Chelsea River. The work will be done in coordination with the neighboring Global Petroleum dredging project, which is very similar. Approximately 13,000 cy of marine sediment will be removed. Sediment will be disposed of in one of the following: a local landfill; a Rhode Island Dredge Disposal Facility; or a CAD cell at the Sterling Marine Terminal site.

Spectacle Island Maintenance Dredging

This project will dredge 16,000 cubic yards of sand from the marina area at Spectacle Island and use it to restore the northern half of West Beach, which has been eroded by wave action. The marina and beach were created in 1996 and 1997, and since then sand from the beach has washed into the marina area, reducing the water depth by up to 10 feet. Approximately 175,000 square feet (4 acres) of subtidal area and 215,000 square feet (4.9 acres) of intertidal area will be temporarily affected. Periodic maintenance dredging is expected to be required in the future.

New South Side Harborwalk

This project will create 350 linear feet of boardwalk along the south side of Commercial Wharf in Boston, supported by about 22 new timber piles. The boardwalk will have a total area of approximately 2,180 square feet and will be part of the Boston Harborwalk system.

Lovejoy Wharf

This project proposes the creation of a mixed-use residential and retail complex adjacent to Lovejoy Wharf, which fronts the Charles River in the North End section of Boston. The project will renovate one existing building at 160 North Washington Street and demolish and replace a second building at 131 Beverly street to create 260 residential units and 38,000 square feet of retail space. Lovejoy Wharf will also be rehabilitated and integrated into the Boston Harborwalk system. No specific impacts to intertidal or subtidal areas are known.

St. Lawrence Cement/Boston Sand & Gravel, Island End River Dredging

This project involves dredging of approximately 10,900 cubic yards of material from an existing commercial wharf owned by Boston Sand & Gravel on the Island End River in Everett. The dredging will cover an area of 81,950 square feet (1.9 acres) and will increase the bottom depth from 26 feet below mean low water (MLW) to 31 feet below MLW, to allow St. Lawrence Cement to dock a new deeper draft vessel at the facility. The dredged material will be removed to an upland disposal site.

Release Abatement Measure, Island End River

This project will dredge approximately 72,000 cubic yards of contaminated sediment in the Island End River adjacent to a former coal tar processing facility. A 1.9-acre confined disposal facility (CDF) will be constructed on the riverbank to contain about 52,000 cubic yards of the dredged material and prevent leaching of toxic organic compounds; the remainder will be removed to an off-site disposal facility. Constructing the CDF will result in permanent impacts to 1.9 acres of subtidal and a small area of tidal flat (intertidal) area, creating new upland area for marine use in a Designated Port Area. A wharf will be constructed atop the CDF.

Old Colony Yacht Club

This project will perform maintenance dredging in the Old Colony Yacht Club Marina, which is located in Boston at the confluence of the Neponset River and Dorchester Bay. Approximately 15,000 cubic yards of sediment will be removed from an area of 80,000 square feet (1.8 acres). A portion of the sediment was contaminated by the former operations of a manufactured gas plant, and will be removed for treatment and upland disposal. The contaminated material will be dredged to a depth of 12 feet below MLW, and the maintenance dredge material will be placed into this deeper channel to recreate the original bottom profile.

Mill Creek Center

This project proposes to construct a 28,000-square-foot mixed-use retail and office building adjacent to Mill Creek in Chelsea. A riverwalk and canoe launch dock would be constructed as public open space along the riverbank. No significant permanent impacts to intertidal and tidal resources are anticipated.

Boston Children's Museum Expansion

This project will construct a three-story, 22,300 square-foot addition to the existing museum building, adjacent to the Fort Point Channel in Boston. As part of the project, the land surface between the museum and the harborwalk along the water will be filled in to create a single level area, and stormwater from the site will be discharged into Fort Point Channel via new drainage treatment and control structures. No fill is proposed in Fort Point Channel.

Table 4-2 presents a summary of the potential impacts to intertidal and subtidal resources in Boston Harbor from the projects listed above.

Table 4-2. Summary of Impacts to Subtidal and Intertidal Resources

Project	Subtidal Impacts	Intertidal Impacts	Comments
Locke Street Salt Marsh	N/A	N/A	Restoration of 30,000 sq ft of salt marsh – supratidal area
Chelsea Sandcatcher Stabilization	None	~ 800 sq ft	
Station #385	None	~ 1,400 sq ft	
Marina Bay Maintenance Dredging	107,800 sq ft (2.5 ac) (9,000 cy dredged)	None	
Long Island Bridge Abutment Stabilization	550 sq. ft. (0.01 acres)	24,000 sq ft temporary; 2,560 sq ft permanent	
Sterling Marine Terminal	60,000 sq ft. – Phase I, 68,000 sq ft. – Phase II	None	
Clippership Wharf	201,070 sq ft (4.6 acres)	14,680 sq ft (0.3 acres)	
Fan Pier Development	9,800 cy – no area specified	None	Temporary impacts to adjacent seawall
Pier 4	unspecified area of maintenance dredging	seawall stabilization	
Yard's End Research Center	None	None	Assumed impacts to adjacent upland areas
Russia Wharf	potential dredging	None	
Winthrop Shores Reservation	1.1 million cy dredged from NOMES I site Area unspecified	Unspecified area resulting from beach nourishment	0.7 million cy to Winthrop Beach (0.4 mil cy to Nantasket)
Hubline	Up to 7,800 acres temporary; 3.7 acres permanent	None	7,300 acres of temporary impact attributed to cable sweep
Central Artery/Tunnel	Spectacle Island – 6.4 acres Ted Williams Tunnel – 3,415 sq ft Fort Point Channel – 2.1 acres Charles/Millers Rivers – 5,000 sq ft	See comments	Spectacle Island and Fort Point Channel impacts include minor unspecified amount of impact to intertidal areas – beach at Spectacle Island, mud flat in Fort Point Channel. Small salt marsh (supratidal) area on Spectacle Island permanently impacted.
Boston Harbor Islands Management Plan	None	None	No specific construction activities identified
Shipyard Quarters Marina Extension	170 sq ft	None	Marina pilings
Pier 5, 8th Street	26 sq ft	None	
Global Petroleum Chelsea River	75,950 sq ft	None	approx. 14,000 cy dredged and disposed in a landfill or CAD cell
Irving Oil Chelsea River	82,706 sq ft	None	approx. 13,000 cy dredged and disposed in a landfill or CAD cell
Spectacle Island Maintenance Dredging	175,000 sq ft (4 acres)	215,000 sq ft (4.9 acres)	dredging of 16,000 cy and nourishment of beach
New South Side Harborwalk	17 sq ft	None	22 timber piles
Lovejoy Wharf	36,213 sf of wharf	None	replacement temporary impacts from pile replacement
St Lawrence Cement Island End River	81,950 sq ft 1.9 acres)	None	10,867 cy of material dredged
Release Abatement, Island End River	53,856 sq ft (1.2 acres)	None	
Old Colony Yacht Club	80,000 sq ft (1.8 acres)	None	15,000 cf of sediment to be dredged
Mill Creek Center, Chelsea	None	None	8,000 sq ft of salt marsh (supra tidal)
Boston Children's Museum Expansion	None	None	All impact to adjacent upland area

Summary of Cumulative Impacts

The Inner Harbor Maintenance Dredging Project will affect previously disturbed subtidal resources of Boston Harbor. The potential cumulative impacts of the projects will be primarily those associated with biological resources and surface water quality.

Based on the summary of the cumulative impact projects previously presented and the timing, location and magnitude of the projects analyzed, the IHMDP is unlikely to result in significant cumulative impacts to water quality with respect to temperature and salinity, dissolved oxygen concentrations or nutrient concentrations. Temporary cumulative local increases in water column turbidity could result if one or more of the upland development projects is being constructed at the same time and in the vicinity of dredging, CAD cell construction or dredged material disposal activities for the IHMDP. Implementation of the proposed IHMDP mitigation measures for dredging and dredged material disposal activities will minimize any potential temporary turbidity impacts.

Likewise, temporary cumulative impacts to biological resources in the Inner Harbor could result if any of the adjacent development projects are being constructed at the same time as IHMDP activities. These potential cumulative impacts could result from additional noise, benthic habitat disturbance, and/or permanent displacement of harbor bottom. Implementation of the proposed mitigation measures for the IHMDP will minimize any potential cumulative impacts.

Overall, the cumulative impacts of the IHMDP are insignificant and temporary in nature. The project involves maintenance dredging of previously disturbed areas in the Inner Harbor and impacts are expected to be limited to the Inner Harbor. Additionally, the project will result in a net benefit to the benthic environment through the sequestering of contaminated silty sediments in the proposed CAD cells to be constructed for the project.

4.8 Comparison of Disposal Alternatives

The BHNIP FEIR/S identified seven sites as potential disposal sites for future maintenance dredged material. The seven sites include the MBDS, Subaqueous B and E, Meisburger 2 and 7, Boston Lightship, and Spectacle Island CAD. The MBDS is an EPA-designated ocean disposal site and the Boston Lightship site is a former disposal site. Both sites are located outside the baseline of the Territorial Sea and are subject to MPRSA. Dredged material that does not meet the ocean disposal criteria would not be allowed at the MBDS. In-channel CAD cells were also considered. In-channel disposal was the preferred alternative in the BHNIP FEIR/S. Room is available in the Main Ship Channel to construct additional CAD cell capacity. The Main Ship Channel is a previously disturbed navigation channel that is similar to the Mystic River, Chelsea River and Inner Confluence identified previously for the BHNIP.

This list of potential disposal sites is still relevant and valid except for the Spectacle Island borrow pit and the location of some of the in-channel (CAD cell) sites. Spectacle Island is currently a component of the Boston Harbor Islands National Park. The construction of the enlarged Spectacle Island and the location of the previously identified borrow pit adjacent to Spectacle Island is inconsistent with park activities precluding this alternative from further analysis. Much of the CAD cell space in the Mystic River has been occupied by the previous BHNIP, and ledge close to the surface in the Inner Confluence or the Chelsea River inhibits the depth needed to construct CAD cells to accommodate the dredged material. This will require a new location for a CAD cell in the Main Ship Channel, just below the Inner Confluence. The new CAD cell would still be located in a previously disturbed navigation channel.

Table 4-3 provides a summary of the relative severity of the impacts for the potential future disposal sites that made the short-list in the Final EIR/S for the BHNIP.

Table 4-3. Summary of Relative Impacts[a] of Potential Aquatic Disposal Alternatives Unsuitable for Ocean Water Disposal (in 103 waters)[b]

DIRECT IMPACTS	SITE STABILITY		DOWNSTREAM IMPACTS		BIOLOGICAL EXPOSURE
	Construction	Post-Construction	Construction	Post-Construction	
In-channel (CAD cells)	**In-channel**	**In-channel**	**In-channel**	**In-channel**	**In-channel**
Spec. Is, Meisburg 2 Meisburg 7	Meisburger 2 Meisburger 7	Meisburger 2 Meisburger 7	Spec. Is, Sub B, Sub E, Meisburger 2 Meisburger 7	Meisburger 2 Meisburger 7	Meisburger 2 Meisburger 7
Sub B Sub E	Sub E Sub B Spec. Is	Sub E		Sub B	Spec. Is
		Sub B Spec. Is		Sub E Spec. Is	Sub B Sub E

[a] Listed in order of least to greatest effect within each impact.
[b] Table modified from the BNHIP Final EIR/S.

The preferred alternative for disposal of the silty material unsuitable for ocean water disposal is in-channel disposal within CAD cells located in the Mystic River and the Main Ship Channel (Figure 2-3). The distinct advantages of using this alternative include confining disposal impacts to the areas impacted by dredging activities, anticipated rapid recovery of biological resources, ability to sequester dredged silts and associated contaminants near their point of origin, and ability to compartmentalize the disposal operation.

Pre-construction water quality modeling performed during preparation of the BHNIP EIR/S, indicated that water quality violations may occur during disposal events at the Subaqueous B and E sites and the Spectacle Island CAD site. Extensive monitoring during construction of the previous BHNIP indicated there were no water quality exceedences during dredging and disposal into the CAD cells. Consequently, no water quality exceedences would be expected during disposal into CAD cells from this proposed project. Creating a borrow pit at the Meisburger sites would be more costly and possibly lengthen the project due to the greater distance from the project area. Also, the Subaqueous B and E sites, the Meisburger sites and the Spectacle CAD sites are all located in previously undisturbed areas. Therefore these sites are not as desirable as disposal sites that have been previously impacted.

4.9 Preferred Alternative and Mitigation

The preferred alternative for the disposal of the dredged material found to be suitable for ocean disposal is the MBDS. The MBDS is the preferred disposal location for suitable material due to its capacity, the fact that it is an active EPA designated disposal site, its previously disturbed nature, favorable cost and low environmental impacts.

Disposal in CAD cells, including a starter cell located in the Mystic River and a super CAD cell in the Main Ship Channel, is the preferred alternative for the unsuitable silty material. Only confirmatory monitoring for initial disposal into each CAD cell is proposed for this project due to the lack of any adverse effects observed during the extensive water quality monitoring program previously implemented during construction of the previous BHNIP. No water quality exceedences were noted during that dredging or disposal monitoring using an enclosed bucket with no scow overflow. Recent extensive monitoring of dredging and disposal during the Providence River maintenance dredging project (another large dredging project in New England) did not detect any water quality violations during construction. Therefore, no water quality exceedences would be expected during dredging or disposal of this project. Dredging of all silty material will be performed with an enclosed bucket and no overflow from the scow will be allowed.

Potential impacts to lobsters and finfish will be minimized by restricting blasting in the navigation channel seaward of the Ted Williams Tunnel between December 1 and March 31. All blasting will be conducted using inserted delays of a fraction of second and stemming shall be rock or similar material placed into the top of the borehole to deaden the shock wave reaching the water column. An approved marine mammal observer will be on-site to confirm that no marine mammals are located in the blast area.

The unsuitable silty maintenance material will be disposed into CAD cells. A three-foot thick sand cap will be placed on top of the silty material to isolate it from the aquatic environment. Capping activities will not begin until tests have been conducted to show that the silt material has sufficiently consolidated to support a sand cap.

Disposal activities within the Mystic River and the Main Ship channel occurring between the period of February 15 and June 15 will be monitored to avoid impacts to anadromous fish. A fisheries observer, a sonar detection system, and a startle system will be used to deter fish away from dredging and disposal operations during this timeframe..

Between February 1 through May 30, disposal vessels, including tugs, barges, and scows, transiting between the dredge site and the MBDS shall operate at speeds not to exceed five knots after sunset, before sunrise, or in daylight conditions. From February 1 through May 30 of any year, an approved marine mammal observer must be present aboard disposal vessels transiting between the dredge site and the MBDS during daylight hours.

To minimize impacts to lobster fishing gear, lobstermen will be provided advance notice of significant dredge movements so that they can relocate their gear.

5.0 MEPA Notice of Project Change

Commonwealth of Massachusetts
Executive Office of Environmental Affairs ■ MEPA Office

For Office Use Only Executive Office of Environmental Affairs
MEPA Analyst: Phone: 617-626-

NPC

Notice of Project Change

The information requested on this form must be completed to begin MEPA Review of a NPC in accordance with the provisions of the Massachusetts Environmental Policy Act and its implementing regulations (see 301 CMR 11.10(1)).

Project Name: **Boston Harbor Navigation Improvement Project**[9]	EOEA #: **8695**	
Street: **Main Ship Channel located approximately half-way between Spectacle Island and Castle Island upstream to the Inner Confluence, the upper Reserved Channel, the approach to the Navy Dry Dock, and a portion of the Chelsea River**		
Municipality: **Boston, Chelsea, Everett**	Watershed: **Boston Harbor**	
Universal Tranverse Mercator Coordinates:	Latitude: Longitude:	
Status of project construction: 0 %complete		
Proponent: **Massachusetts Port Authority**		
Street: **One Harborside Drive, Suite 200S**		
Municipality: **East Boston**	State: **MA**	Zip Code: **02128-2909**
Name of Contact Person From Whom Copies of this NPC May Be Obtained: **Jacquelyn Wilkins**		
Firm/Agency: **Massport**	Street: **One Harborside Drive, Suite 200S**	
Municipality: **East Boston**	State: **MA**	Zip Code: **02128-2909**
Phone: **(617) 568-3558**	Fax: **(617) 568-3518**	E-mail: **jwilkins@massport.com**

In 25 words or less, what is the project change? **Maintenance dredging of areas of Boston Inner Harbor and disposal of sediment in Confined Aquatic Disposal (CAD) cells beneath the federal navigation channel and at the Massachusetts Bay Disposal Site.** See full project change description beginning on page 5-3

9 This NPC addresses maintenance dredging of areas of Boston Inner Harbor –referred to as the Inner Harbor Maintenance Dredging Project.

Date of ENF filing or publication in the Environmental Monitor: **May 8, 1991**
was an EIR required? ☒Yes ☐No; if yes,
was a Draft EIR filed? ☒Yes (Date: **April 25, 1994**) ☐No
was a Final EIR filed? ☒Yes (Date: **August 8, 1995**) ☐No
was a Single EIR filed? ☐Yes (Date:) ☒No

Have other NPCs been filed? ☒Yes (Date(s): **05/22/1996; c. 01/24/98; 03/25/1998; c. 04/07/1999**) ☐No

If this is a NPC solely for lapse of time (see 301 CMR 11.10(2)) proceed directly to "**ATTACHMENTS & SIGNATURES"** on page 4.

PERMITS / FINANCIAL ASSISTANCE / LAND TRANSFER
List or describe all new or modified state permits, financial assistance, or land transfers not previously reviewed:

MA DEP Section 401 Water Quality Certification
MA CZM Consistency Determination

Are you requesting a finding that this project change is insignificant? (see 301 CMR 11.10(6)) ☒Yes ☐No; if yes, attach justification.

Are you requesting that a Scope in a previously issued Certificate be rescinded?
☐Yes ☒No; if yes, attach the Certificate

Are you requesting a change to a Scope in a previously issued Certificate? ☐Yes ☒No; if yes, attach Certificate and describe the change you are requesting:

Summary of Project Size & Environmental Impacts	Previously reviewed	*Net Change*	Currently Proposed
LAND			
Total site acreage*	117	732**	732**
Acres of land altered	N/A	N/A	N/A
Acres of impervious area	N/A	N/A	N/A
Square feet of bordering vegetated wetlands alteration	N/A	N/A	N/A
Square feet of other wetland alteration	117	732**	732**
Acres of non-water dependent use of tidelands or waterways	N/A	N/A	N/A
STRUCTURES			
Gross square footage	N/A	N/A	N/A
Number of housing units	N/A	N/A	N/A
Maximum height (in feet)	N/A	N/A	N/A
TRANSPORTATION			
Vehicle trips per day	N/A	N/A	
Parking spaces	N/A	N/A	N/A
WATER/WASTEWATER			
Gallons/day (GPD) of water use	N/A	N/A	N/A
GPD water withdrawal	N/A	N/A	N/A
GPD wastewater generation/ treatment	N/A	N/A	N/A
Length of water/sewer mains (in miles)	N/A	N/A	N/A

* All areas are subaqueous within Boston Harbor. ** Maintenance dredging affects areas different than the BHNIP, therefore the "Net Change" is the same area as the "Currently Proposed" area

Does the project change involve any new or modified:

1. conversion of public parkland or other Article 97 public natural resources to any purpose not in accordance with Article 97? ☐Yes ☒No

2. release of any conservation restriction, preservation restriction, agricultural preservation restriction, or watershed preservation restriction? ☐Yes ☒No

3. impacts on Estimated Habitat of Rare Species, Vernal Pools, Priority Sites of Rare Species, or Exemplary Natural Communities? ☐Yes ☒No

4. impact on any structure, site or district listed in the State Register of Historic Place or the inventory of Historic and Archaeological Assets of the Commonwealth?

☐Yes ☒No; if yes, does the project involve any demolition or destruction of any listed or inventoried historic or archaeological resources? ☐Yes ☐No

5. impact upon an Area of Critical Environmental Concern? ☐Yes ☒No

If you answered 'Yes' to any of these 5 questions, explain below:

PROJECT CHANGE DESCRIPTION (attach additional pages as necessary). The project change description should include:

(a) a brief description of the project as most recently reviewed

(b) a description of material changes to the project as previously reviewed,

(c) the significance of the proposed changes, with specific reference to the factors listed 301 CMR 11.10(6), and

(d) measures that the project is taking to avoid damage to the environment or to minimize and mitigate unavoidable environmental impacts. If the change will involve modification of any previously issued Section 61 Finding, include a proposed modification of the Section 61 Finding (or it will be required in a Supplemental EIR).

Project Description

The Massachusetts Port Authority (Massport) intends to act as the non-federal sponsor for the US Army Corps of Engineers (Corps) which is proposing to maintenance dredge areas of Boston Harbor adjacent to and in areas previously reviewed as the Boston Harbor Navigation Improvement Project (BHNIP), EOEA 8695.

Need for the Maintenance Dredging Project

The Port of Boston serves the six-state New England region, and is the region's primary container port. Large tankers and freighters, which transit the harbor to load and unload goods, currently experience significant tidal delays due to shoals that have developed since the last maintenance dredging of this portion of the Inner Harbor navigation channels in 1969.

The Corps completed BHNIP dredging in 2001. Massport was an active co-sponsor for this project, which resulted in deepening of key tributaries and portions of the Main Ship Channel to -40 feet MLLW and related berths to depths ranging from -35 to -45 feet MLLW. While the lengthy planning, permitting, design and construction process for this project was underway, the other portions of the shipping channels into Boston Harbor continued to shoal and now need maintenance dredging to restore them to their authorized depths of -35 and -40 feet.

Failure to dredge Boston Harbor will further restrict and delay commercial deep draft vessels. Shoaling has reduced depths in the channel as much as five feet in some sections of the project area. This situation greatly affects the commercial ships using the harbor. Without maintenance dredging to restore authorized depths in the inner portion of the Main Ship Channel, shippers will experience even longer tidal delays and be restricted to operating within narrower time periods of higher tidal stages. This will increase the cost of shipment of products and will significantly impact the economic viability of the most important port in the New England region. With the increase of costs and the reduction in vessel movement opportunities, it is likely that shippers will by pass the port and will unload product at other ports and ship the products via trucks which would impact limited roadway capacity.

The 40-foot Main Ship Channel into the Port of Boston has shoaled in to the extent that -35 feet MLLW is now the controlling depth. As a result, the deepest draft vessel that can be brought in without any regard to tides is 33 feet. (This does not take into account strong westerly winds that can further reduce available water depths by as much as 2 feet.) In 2005, there were greater than 600 movements in Boston Harbor by "tide-restricted" vessels (i.e., vessels with drafts of 34 feet or greater). This results in a significant and negative economic impact to the region, and it raises significant operational, safety, economic and environmental concerns. The lack of depth would also increase the likelihood of vessel grounding leading to increased ship repair and maintenance costs. Shippers will also need to lighter (transfer) their cargo in the outer harbor, thereby increasing costs to consumers and the chances for an oil spill in these harbor areas. In the worst case, these severely shoaled channels could result in a ship grounding, with potentially devastating environmental consequences

The Port of Boston provides significant economic benefits to the Commonwealth's residents and businesses. The Port is credited with generating 34,000 jobs and a $2.4 billion annual economic impact. This significant economic benefit could be jeopardized by the current severe state of shoaling in our channels, since the economic viability of any port rests in large part on the depths of its navigation channels. If deep draft vessels cannot safety and efficiently transit the harbor to access their channels, significant economic and potential environmental impacts result. Also, waterborne transportation of cargo is the most environmentally sound transportation alternative available. If cargo cannot reach its destination by water, it will be diverted to the highways, resulting in increased air emissions, traffic and deterioration of highways and bridges.

BHNIP Project Description as Previously Reviewed

The BHNIP was a joint project between the Corps and Massport, consisting of maintenance and improvement dredging in channels and berths within the Inner Harbor. The BHNIP project included the removal of approximately 1 million cubic yards (CY) of silty maintenance material, 1 million CY of improvement material (also referred to as parent material and composed primarily of Boston blue clay) and an additional 1.4 million CY of parent material for the construction of disposal cells. A portion of the Mystic River, Inner Confluence, and Reserved Channel Federal navigation channels were deepened from -35 feet mean lower low water (MLLW) to- 40 feet MLLW while the Chelsea River was deepened from -35 feet MLLW to -38 feet MLLW. Figure 5-1 illustrates the limits of the BHNIP. A number of berths were also deepened to various depths.

Based on biological testing results, the BHNIP maintenance material was determined by the EPA to be unsuitable for unconfined ocean disposal and instead was disposed of in confined aquatic disposal (CAD) cells. The Water Quality Certification for the project authorized the construction of 54 individual CAD cells (see Figure 5-2). The CAD cells were located within the dredging project footprint in the Federal navigation channels and were capped with sand following completion of disposal. Improvement material was disposed at a designated offshore disposal site in the Massachusetts Bay Disposal Site (MBDS).

The BHNIP was constructed in two phases. Phase I included limited berth dredging at Conley Terminal in South Boston to allow for its use by deep draft container vessels. Phase I work involved the construction of a single CAD cell in the Inner Confluence for disposal of unsuitable sediments and was completed in the summer of 1997. Phase II comprised the main portion of the project and included construction of eight additional CAD cells. The eight CAD cells ranged in capacity from approximately 28,000 to 349,000 CY with cell depths up to a maximum of 70 feet below the surrounding harbor bottom. Approximately 1.4 million CY of parent material was removed to create the cells and disposed of at the MBDS. A total of 1 million CY of maintenance material was disposed of into the CAD cells. See Figure 5-3 for the location of the constructed BHNIP CAD cells.

The BHNIP environmental review and permitting involved an extensive public and agency outreach process that included the following elements:

- Early in the project planning process, Massport and the Corps identified and sought input from project stakeholders and potential adversaries through an extensive public participation process consisting primarily of a series of public meetings and a broad-based Dredging Advisory Committee supplemented by focused technical working groups (i.e., the Sediment Characterization Technical Working Group and the Disposal Options Technical Working Group). More than 20 meetings were held with the advisory committee and working groups.
- Massport and the Corps engaged in regular meetings with representatives from the Massachusetts Executive Office of Environmental Affairs (EOEA) agencies throughout the permitting process to discuss technical or regulatory issues. Coordination, management, and follow-up related to these meetings was greatly facilitated by EOEA's appointment of a primary contact person for the project.
- A series of formal and informal meetings were held between the federal cooperating agencies and the Corps to address federal issues such as selection of the "least environmentally damaging practicable alternative" for disposal.

As a result of early involvement of all project stakeholders in the project planning process through mechanisms such as those listed above, the various stakeholders developed a better understanding and appreciation of each others needs and concerns related to the project and a ultimately a commitment to the same goals.

The public participation process did not end once the project was permitted. Instead, a separate Technical Advisory Committee (TAC) was convened to meet regularly with representatives from Massport, the Corps, the contractor, and the regulatory agencies throughout the construction process. The TAC, which was comprised of members of various environmental agencies, environmental advocacy groups, academic interests, and public representatives, was chaired by the Independent Observer (IO) that was funded by Massport to independently oversee the project and ensure that all permit conditions were met. The IO compiled observations and data from the construction process and presented and interpreted his findings to the TAC, with input from Massport, the Corps and the contractor. In conjunction with the state regulatory officials, the IO also periodically convened broader public meetings to discuss the project progress and issues. Although numerous issues arose during the first phase of BHNIP, as could be expected on any large-scale dredging project, all issues were resolved via the TAC so that the public's concerns were alleviated and the project moved forward without any delays or negative publicity.

Project Description – Inner Harbor Maintenance Dredging Project (IHMDP)

Massport intends to act as the non-federal sponsor for the Corps, which is proposing, to maintenance dredge areas of Inner Boston Harbor adjacent to areas previously reviewed as the BHNIP. This Notice of Project Change addresses work to be done in Boston's Inner Harbor, referred to as the Inner Harbor Maintenance Dredge Project (IHMDP), and specifically involves restoring the Main Ship Channel to authorized depths:

- in the reaches from a point halfway between Spectacle and Castle Islands upstream to the Inner Confluence;
- the upper portion of the Reserved Channel, and
- the approach to the Navy Dry Dock.

In conjunction with this work, the Corps also hopes to complete maintenance and improvement dredging surrounding the Keyspan Gas Siphon in the Chelsea River. This dredging was permitted as part of BHNIP, but was never completed because the pipeline has not yet been removed. The Corps, Massport and the Commonwealth continue to work together to have Keyspan Gas remove the pipeline. If the line is removed prior to completion of the Inner Harbor Maintenance Dredging Project, the BHNIP maintenance and improvement dredging will be performed in this area to deepen the Chelsea River to its –38 foot MLLW authorized depth. If the line is not removed in time, then the Chelsea River area will be maintenance dredged to –35 feet MLLW. The maintenance material will be disposed into CAD cell C12, located north of the Chelsea Street Bridge, which was permitted and constructed for the BHNIP, and the improvement material would be disposed of at MBDS.

The IHMDP area is illustrated in Figure 5-4. The majority of dredge material from these sections will be unsuitable for ocean disposal at the MBDS and will require state permits for disposal in CAD cells.

Recent surveys have identified some areas of ledge within the Federal navigation project that will also be removed as part of this maintenance dredging effort: a section of ledge, located in the Main Ship Channel between the 35 and 40-foot channels; as well as six separate ledge outcrops in the west end of the President Roads Anchorage.

The total quantity of maintenance material expected to be dredged is about 1.7 million cy, of which 1.3 million has been found to be unsuitable for ocean disposal. This unsuitable material will be disposed into CAD cells. The remaining 400,000 cy of material is suitable for disposal at the Massachusetts Bay Disposal Site (MBDS). An additional 1.5 million cy of parent material will be dredged to construct the CAD cells and disposed of at MBDS. Approximately 350 cy of rock would be removed from the Main Ship Channel and 11,350 cy of rock would be removed from the President Roads Anchorage.

While there is some available capacity remaining in the so-called "Super Cell" constructed for the BHNIP, the capacity is insufficient to accommodate the anticipated volume of unsuitable dredged material for this maintenance project. Rather than using the limited Super Cell capacity, a new location for a CAD cell has been identified within the limits of the existing navigation channel. A second CAD cell will be constructed within the previously permitted BHNIP area. The CAD cells will be located in the Mystic River navigation channel and the Main Ship navigation channel. The IHMDP CAD cell locations are illustrated in Figure 5-5.

Lessons Learned from the Boston Harbor Navigation Improvement Project

Dredging and disposal operations for the BHNIP project were monitored and analyzed extensively during the project and in subsequent years. Efforts included: studies of water quality and sediment plume tracking during and following dredging and disposal activities; biological testing of the dredged sediment; dissolved oxygen testing; fisheries monitoring during dredging and disposal; evaluation of two different environmental clamshell buckets; high tide vs. low tide disposal; vessel passage over uncapped CAD cells; bathymetric surveys of the CAD Cells; and lobster monitoring. As a result much was learned that will be applied by the Corps and Massport to conduct the IHMDP in an environmentally safe manner incorporating the lessons learned from the BHNIP that have proven to result in the least environmental impact. Project design and contract specifications will reflect these lessons learned as summarized below.

Silt Plume Control

The Water Quality Certification for the BHNIP required specific measures to minimize fine sediments during dredging and CAD cell disposal operations.

Dredging and disposal of the unsuitable dredge material was to be conducted in the following manner:

- A closed environmental clamshell bucket was used to dredge the unsuitable dredge material. During the BHNIP, two types of closed environmental clamshell buckets were used (the Cable Arm brand and a comparable bucket developed by Great Lakes Dredge and Dock) and were determined to be effective in minimizing the resuspension of the unsuitable dredge material throughout the water column
- A 3-hour window during slack tide conditions for CAD cell disposal activities - 1 hour before to 2 hours after high or low tide - was determined to be protective of harbor water quality. Subsequent water quality monitoring during CAD cell disposal activities demonstrated that there were no exceedences of specified criteria during and following the disposal events, as specified below.

Sand Cap for CAD Cells

A 3-foot sand cap placed on top of the unsuitable material in the CAD cells, after a suitable period of time for consolidation of the unsuitable material after disposal, was determined to be effective.

Anadromous Fish Protection

Measures to protect indigenous anadromous fish species in the harbor included:

- No blasting in the Mystic River and Inner Confluence from February 15th to June 15th;
- CAD cell excavation and disposal activities upstream of the Tobin Bridge and in parts of the Inner Confluence required a fisheries observer, a sonar system to detect schools of fish and fish startle system between February 15th to June 15th. Activity in the remaining areas in the Inner Confluence were to be avoided during this same time period.

During the BHNIP, blasting activities in the Mystic River and the Inner Confluence were limited to summer with no impacts to fisheries resources noted. During CAD cell excavation and disposal activities, very few fish were observed during colder months. More fish were observed in the spring, but no large schools of fish were observed in the vicinity of the CAD cells throughout the BHNIP.

Suspended Sediment Plume Tracking During Dredging and Disposal

One of the strongest findings of the BHNIP monitoring and evaluation program was that the extensive predictive water quality modeling performed for the EIR and the Water Quality Certificate greatly overestimated the project impacts. Where the modeling predicted some exceedences of water quality standards, in fact all dredging and disposal monitoring results were in compliance with the surface water quality criteria. Plume tracking investigations performed during dredging operations indicated all monitored values returned to background within 600 to 1000 feet down current. A total of five investigations performed after CAD cell disposal operations found elevated turbidity within the boundaries of the CAD cell, with only limited down current transport. In the worst case disposal event (disposal from 3 dump scows within one 3-hour high tide window into the "Super Cell" in the Inner Confluence) , no significant plume was detected beyond 300-feet down current.

Water Quality Monitoring

Additional water quality monitoring was performed 300-feet down current of the CAD cells following disposal events. Acute criteria were monitored at ½ hour and 1 hour following the disposal events, while chromic criteria were monitored at hourly intervals between 4 and 6 hours after the disposal events. Monitoring results (total of 18 monitoring events) indicated that there were no exceedences of the water quality criteria listed in the Water Quality Certification.

Biological Testing

Biological testing of the dredged sediment, including bioaccumulation with the blue mussel (*Mytilus edulis*), the fertilization test with the sea urchin and the endpoint test with the Mysid shrimp, indicated that there were no negative impacts from disposal of the BHNIP sediments.

Dissolved Oxygen (DO) Monitoring

Due to concerns that DO concentrations in the water column over the CAD cells may be lower than the surrounding harbor waters, monitoring of DO concentrations was conducted and found that the DO levels over the CAD cells was similar to the surrounding waters. DO concentrations in Boston Harbor decrease as water temperature increases, and ambient concentrations below the 5 mg/l water quality standard are common.

Fisheries Protection

The Water Quality Certification included detailed conditions intended to protect winter flounder spawning and anadromous fish (rainbow smelt, blueback herring and alewife) runs during late winter and early spring. These conditions prohibited all blasting activities as well as CAD cell excavation and disposal activities in the Mystic River and Inner Confluence during the period from February 15 through June 15. During the BHNIP, blasting was only performed in the upper Chelsea River during August 2001. No impacts to any extant fisheries resources were observed.

CAD cell construction and disposal activities were conducted during much of the February to June period in 1999 and again for a limited period in 2000. During these periods, a vessel equipped with sonar and a fish startle system surveyed the area of the CAD cell construction activities, and again surveyed the areas surrounding specific CAD cells immediately prior to disposal events. The startle system was to be used only in the event large numbers of fish were encountered. The results of the monitoring indicated that very few fish were detected in colder months. As harbor waters warmed during the spring, more individual fish were observed, but at no time were any large numbers of fish observed within the immediate area of dredging and disposal activities.

Time of Disposal

The Water Quality Certification required that disposal of silt into the CAD cells be restricted to a three hour period of 1 hour before to 2 hours after high tide. As disposal operations progressed, vessel passage in the harbor during high tide (including liquefied natural gas (LNG) tankers) interfered with disposal activities resulting in disposal being delayed beyond the 2 hour window post-high tide window. As a result, a request was made of the DEP to allow for disposal during low tide conditions as well. Additional water quality monitoring as required for high tide disposal was performed to measure the impacts of low tide disposal, and the monitoring indicated results similar to high tide disposal (limited turbidity and no exceedences of relevant water quality criteria). As a result, low tide disposal within 2 hours after low tide was allowed for the BHNIP.

Lobster Monitoring

During the environmental review and public and agency outreach process, local lobstermen expressed concerns about dredging impacts to lobsters in the harbor including juveniles and egg-bearing females. Particular concern was raised regarding dredging activities in warmer months in the Reserved Channel.

As a result of these concerns, a series of measures were undertaken to assess potential impacts to lobsters from the dredging and disposal operations:

- The MA Division of Marine Fisheries increased observers on lobster vessels;
- The BHNIP Independent Observer also began a separate program to document the lobster catch in the Reserved Channel;
- Dredged material was screened in the dump scows to determine whether lobsters were present; and
- An underwater video survey of areas to be dredged was conducted.

Results of these investigations indicated that although juvenile lobsters were found, they were not present in large numbers. No lobsters were ever found during oversight of dredging operations or in the dredged material in the dump scows. These results suggest that there were minimal impacts to the lobster fishery in the harbor; most likely due to the ability of larger lobsters to avoid areas of disturbance.

Assessment of CAD Cell Capping (5 year monitoring report)

A final significant lesson learned as a result of the BHNIP concerned the long term integrity of the CAD cell capping. An investigation of nine previously constructed CAD cells in Boston Harbor was performed in August 2004 as part of the Corps' New England District Disposal Area Monitoring System (DAMOS).

Given that use of CAD cells within the footprint of a navigable channel was a relatively new technique at the time of the BHNIP, a series of investigations were performed during and following completion of the project to assess the effectiveness of dredged material disposal into the cells and cap placement. The August 2004 investigation was performed as a longer term follow up, four to seven years following completion of individual CAD cells and included performance of bathymetric, side-scan sonar, underwater video and sediment-profile imaging surveys. The investigation was designed to 1) assess the general physical status of the surface of each CAD cell to evaluate cell stability; and 2) assess the benthic recolonization status of each of the nine CAD cells.

The high resolution swath bathymetry and side-scan sonar data collected as part of the August 2004 survey revealed that all nine CAD cells remained as stable structures with no evidence of significant cap disturbance or scour. As expected, limited further consolidation of the material within the cells has taken place, and some erosion of the exposed sidewalls of the cells that rise steeply above the cell surface has also occurred. Both of these processes are expected to continue into the future, but without effect on the overall structure or integrity of the cells.

Regarding benthic recolonization of the capped CAD cells, the report concludes:

> "…general benthic habitat conditions observed within the cells and reference areas were indicative of a consistently stressed environment. The continual exposure to stressful conditions limited the recolonization and successional status of both the CAD cells and associated reference areas. The result was an environment in a perpetual state of early succession. This was expected given periodic episodes of poor water quality and physical disturbance associated with a working harbor."

Conclusions on Lessons Learned/IHMDP Recommendations

With consideration of the "Lessons Learned" summarized above, the Inner Harbor Maintenance Dredging Project will incorporate the following environmental mitigation measures:

- An enclosed "environmental" bucket will be used for all silt dredging.
- To reduce the effects of turbidity on water quality, no overflow from the scows will be allowed.
- Disposal into the CAD cells will occur only around periods of slack tide: three hours at low tide and high tide (one hour before and two hours after slack tide).
- A three-foot sand cap will be placed in the CAD cells when the silt has consolidated enough to support a cap. The cap material will be released from a moving, not stationary platform. No spudding will be allowed over the cap and no mechanical disturbance of the cap will be allowed.
- To reduce the impact to biological resources from blasting, all blasting will be conducted using inserted delays of a fraction of a second per hole. Rock or similar material will be placed into the top of the borehole to deaden the shock wave reaching the water column. A fisheries and mammal observer, and fish detecting sonar system, will be used to avoid blasting when mammals are present in the area or when significant schools of fish are observed.
- A fisheries observer, sonar detection, and a startle system from February 15 to June 15 will be required for the Mystic River and Main Ship Channel CAD disposal activities to avoid disposal during the presence of anadromous fish migration.
- To reduce potential impacts to egg-bearing lobsters that are less mobile in the colder months, no dredging or blasting will occur seaward of the Ted Williams Tunnel between December 1 and March 31.
- A marine mammal observer will be on board the scows transiting to the MBDS from February 1 to May 31 to avoid potential ship strikes with marine mammals, and in particular the North Atlantic Right Whale.
- Rock removed from the project area will be placed within a new area of the MBDS to increase habitat diversity.
- The dredge contractor will provide advance notice to the lobstermen on anticipated significant dredge movements.

In addition, turbidity and total suspended solids will be monitored during the first time disposal occurs into the CAD cell located in the Mystic River and the CAD cell located in the Main Ship Channel to confirm minimal water quality impacts.

Findings

In order to determine whether a change in a previously reviewed project requires further review under MEPA, the Secretary of Environmental Affairs must consider the environmental consequences of the proposed changes, and make a finding as to whether the proposed changes require additional review under MEPA. The criteria for the findings are listed at 301 CMR 11.10(6). Listed below is information in support of Massport's contention that the changes to the BHNIP described in this NPC are insignificant.

- 11.10(6)(a) – *Expansion of the project.* The changes described in this NPC do not result in an expansion of the BHNIP project. All dredging operations involve maintenance of previously dredged navigation channels and no expansion or deepening of the navigation channels is proposed. The new CAD cells proposed will be located entirely within the previously disturbed area of the existing navigation channel.

- 11.10(6)(b) – *Generation of further impacts.* The construction of two new CAD cells beneath the existing federal navigation channels does not result in the generation of further impacts beyond those originally anticipated in the BHNIP EIR/S, particularly in light of the extensive monitoring results that indicated that there were no significant environmental impacts associated with BHNIP. Since this additional maintenance dredging and disposal will result in containment of an additional approximately 1.3 million cy of "unsuitable" material beneath a 3-foot sand cap and out of contact with the water column, this additional dredging and disposal will result in a net environmental benefit to Boston Harbor.

ATTACHMENTS & SIGNATURES

Attachments:

1. Secretary's most recent Certificate on this project
2. Plan showing most recent previously-reviewed proposed build condition
3. Plan showing currently proposed build condition
4. Original U.S.G.S. map or good quality color copy (8-1/2 x 11 inches or larger) indicating the project location and boundaries
5. List of all agencies and persons to whom the proponent circulated the NPC, in accordance with 301 CMR 11.10(7) is provided in Chapter 11 of the DSEIS.

Signatures:

12/27/05	Jacquelyn I. Wilkins	12/27/05	Joseph Freeman JW
Date	Signature of Responsible Officer or Proponent	Date	Signature of person preparing NPC (if different from above)

Jacquelyn I. Wilkins	Joseph Freeman
Name (print or type)	Name (print or type)
Massachusetts Port Authority	Earth Tech
Firm/Agency	Firm/Agency
One Harborside Drive	196 Baker Avenue
Street	Street
East Boston, MA 02128	Concord, MA 01742
Municipality/State/Zip	Municipality/State/Zip
617-568-3558	978-371-4208
Phone	Phone

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street, Boston, MA 02202

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Deb H

February 24, 1998

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
NOTICE OF PROJECT CHANGE

PROJECT NAME	: Boston Harbor Navigation Improvements
PROJECT LOCATION	: Boston
EOEA NUMBER	: 8695
PROJECT PROPONENT	: Massachusetts Port Authority

Pursuant to the Massachusetts Environmental Policy Act (G.L. c. 30, ss. 61-62H) and Section 11.17 of the MEPA regulations (301 CMR 11.00), I have reviewed the Notice of Project Change submitted on this project and hereby determine that it **does not require** further MEPA review.

The original project involved the dredging of approximately 2.4 million cubic yards (cy) of material from channels and berths within Boston Harbor. Further design details on the project have caused some minor changes to the original project. While these changes warrant the filing of this Notice of Project Change, I do not find that they warrant either public review or further environmental review. MassPort has reviewed these changes with the permitting agencies and with the Technical Advisory Committee and the agencies are prepared to issue revised permits reflecting these changes.

The changes include the following:

1. Recent refined survey data indicate that the overall volumes of parent material and silt to be dredged have decreased by 18 and 12 percent respectively.

2. The recent survey identified an additional 30,000 cy to be dredged in the Main Ship Channel.

3. The Medford Street Terminal (formerly Revere Sugar) will be dredged to -40 feet rather than -35 feet resulting in an increase of 15,200 cy of parent material to be dredged.

4. The Army Corps of Engineers may want to conduct a study of the impacts of dredging and dredged material disposal on fisheries. If such a study is undertaken, the fish deterrent

system proposed for the project would not be employed while the study was underway.

I find that these changes are minor in nature and are unlikely to result in additional environmental impact. No further MEPA review is required.

February 24, 1998
DATE

Trudy Coxe, Secretary

Comments received : None

TC/rf

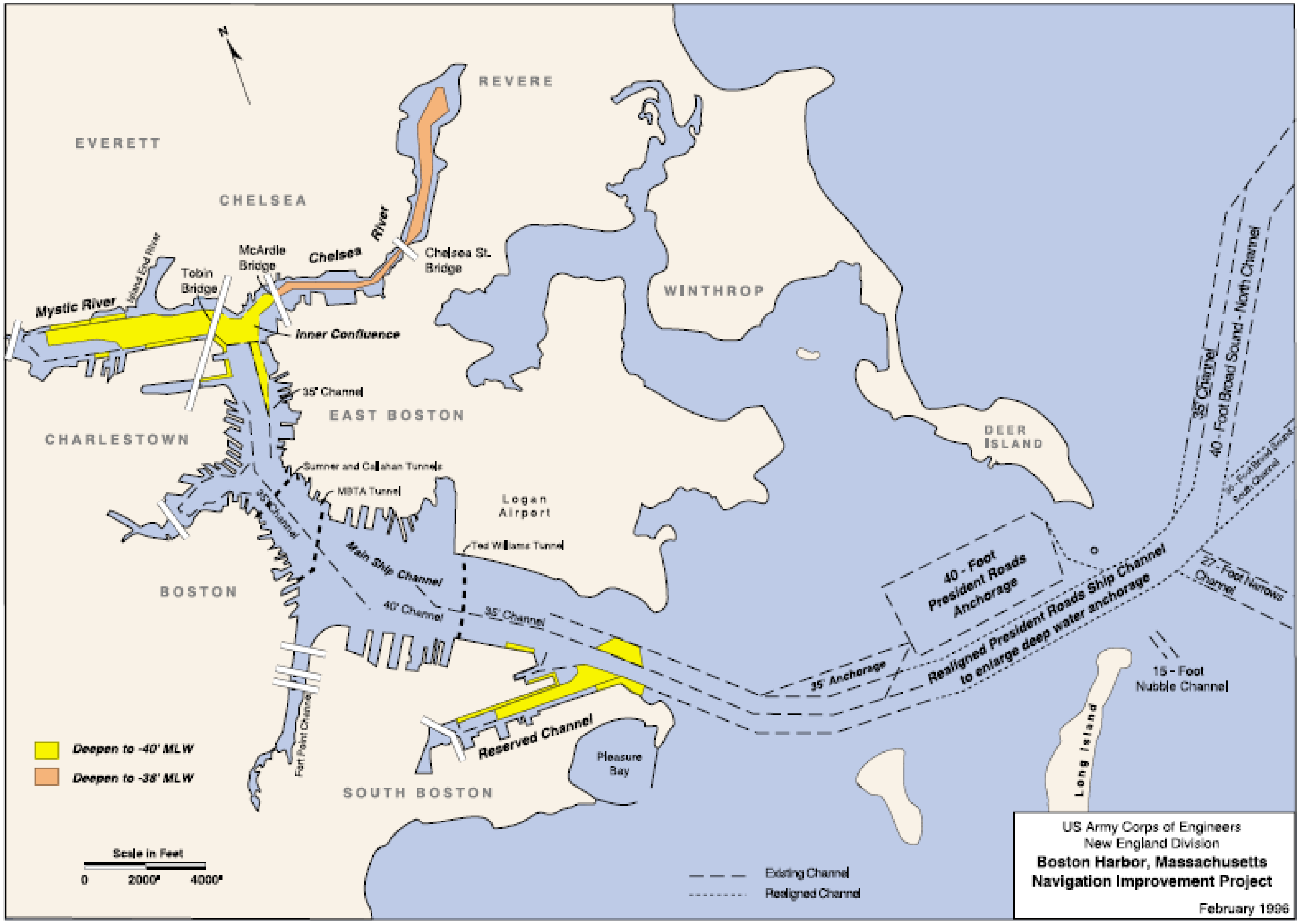

Figure 5-1. BHNIP Dredging Area

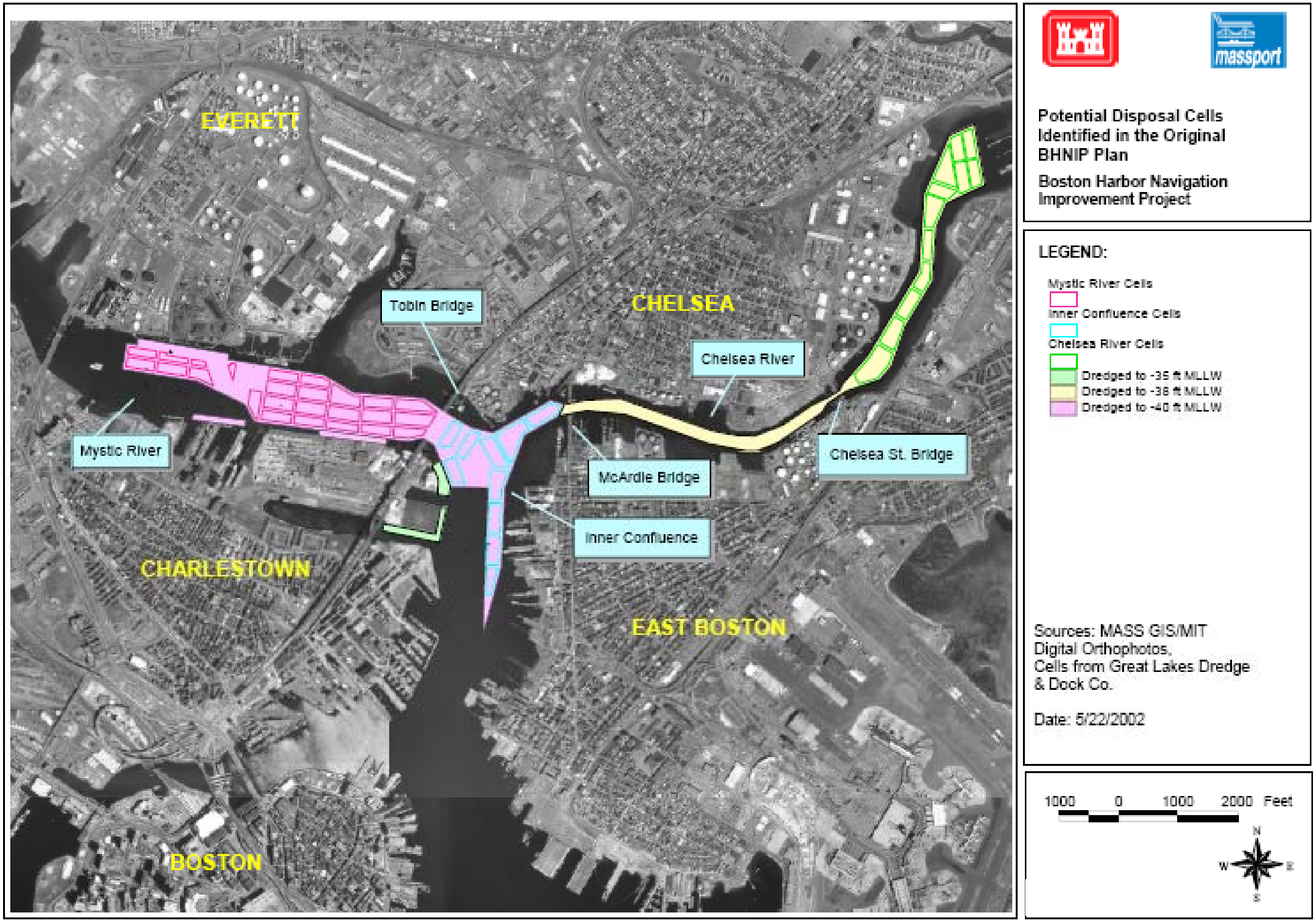

Figure 5-2. Approved BHNIP CAD Cell Locations

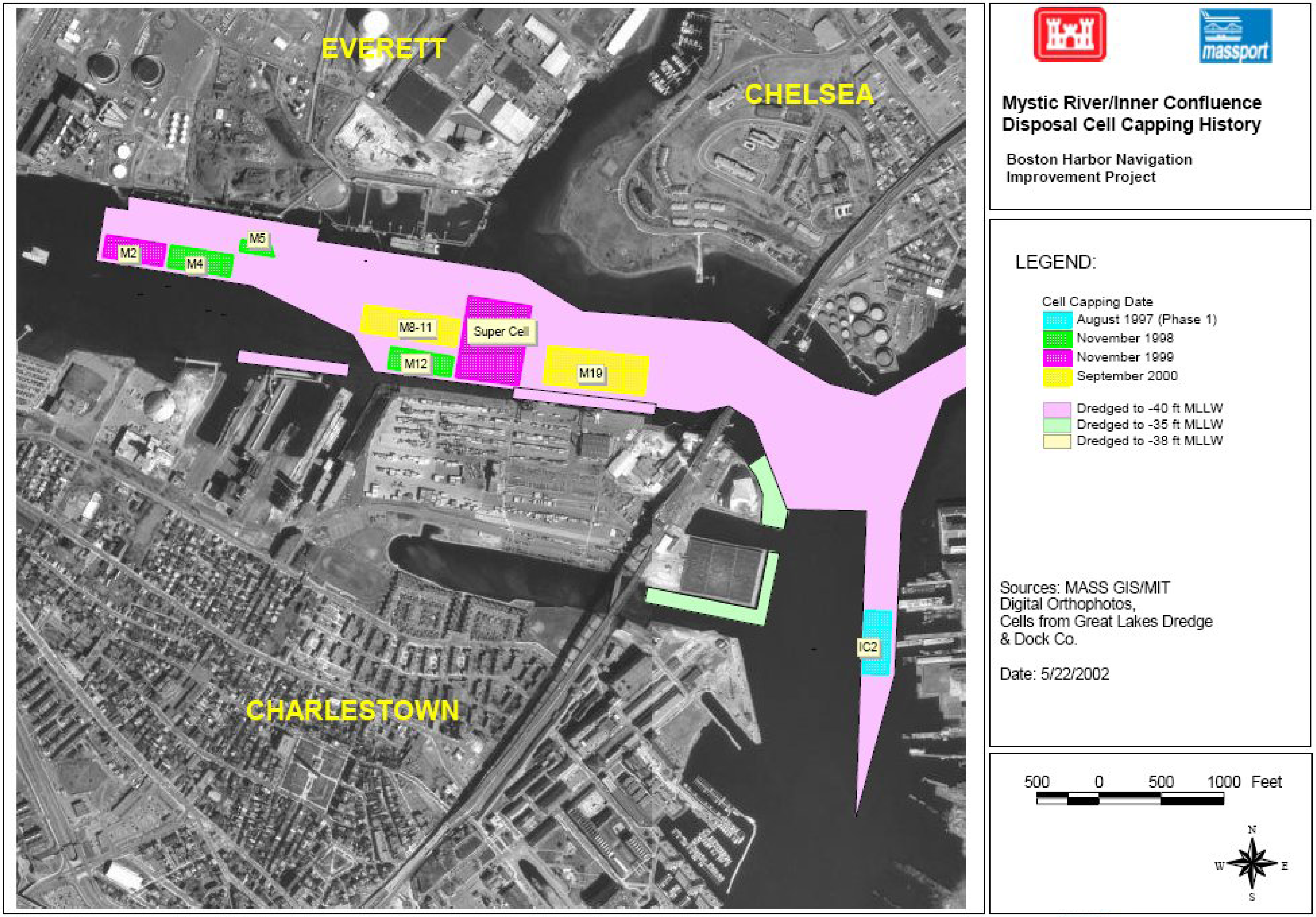

Figure 5-3. Actual BHNIP CAD Cell Locations

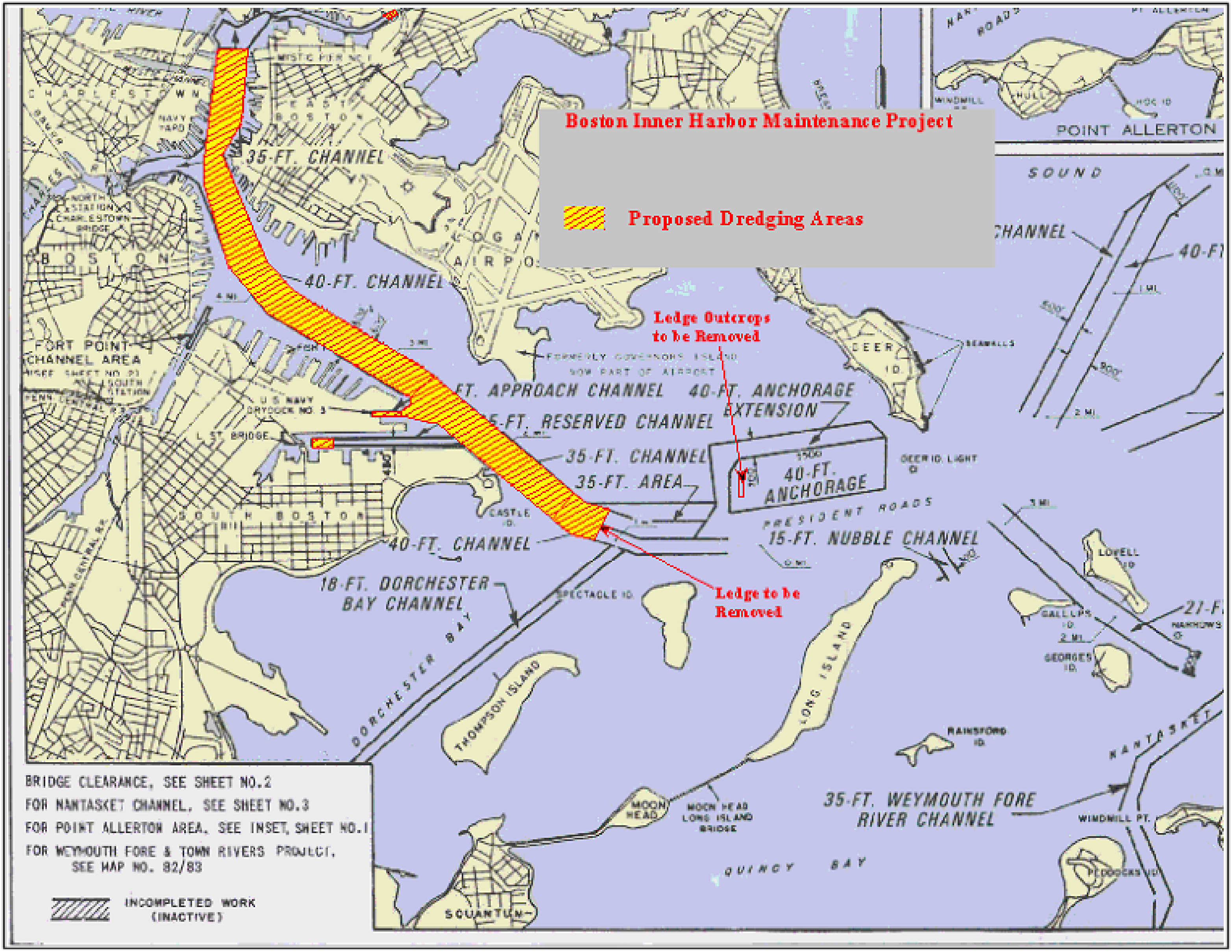

Figure 5-4. IHMDP Dredging Area

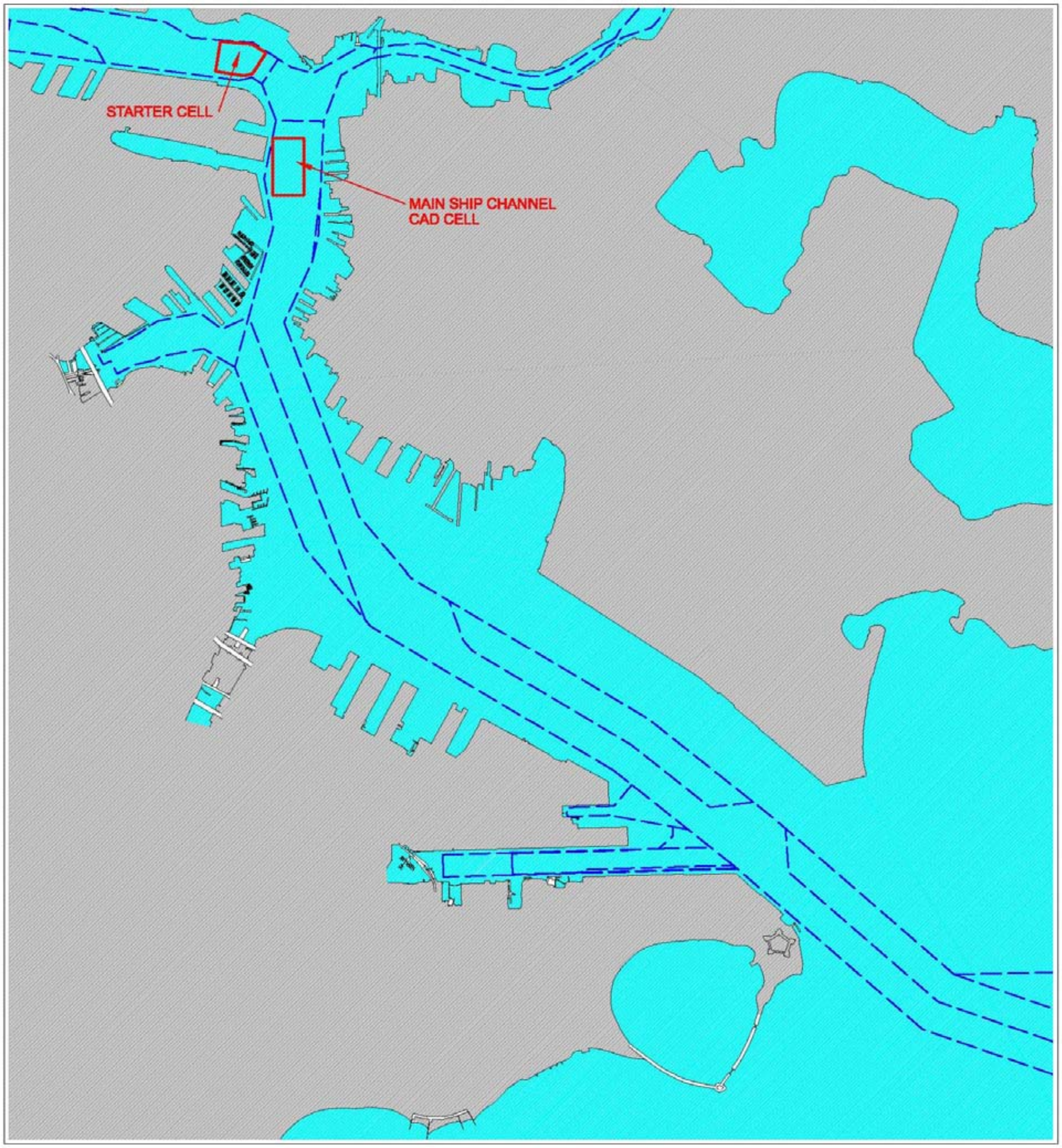

Figure 5-5. IHMDP CAD Cell Locations

6.0 Agency Coordination and Compliance

6.1 Cooperating Agency Request

The National Environmental Policy Act (NEPA) encourages early agency cooperation. Federal agencies that have jurisdiction by law shall be a cooperating agency or may be a cooperating agency due to their special expertise. Cooperating agencies shall participate in the NEPA process at the earliest possible time, participate in scoping meetings, help prepare information or environmental analyses which the cooperating agency has expertise, and provide staff support as requested by the lead agency (Corps) to enhance interdisciplinary capability. Cooperating Federal agencies that have jurisdiction by law include the Environmental Protection Agency, the U.S. Fish and Wildlife Service and NOAA-Fisheries. A letter requesting cooperating agency participation was sent by the Corps to the three Federal agencies on July 6, 2005.

A response was received from the Environmental Protection Agency and NOAA-Fisheries Service agreeing to participate as cooperating agencies on this Supplemental EIS/Notice of Project Change (EIS/NPC). See Appendix D for a copy of the correspondence. No response was received from the U.S. Fish and Wildlife Service regarding their desire to participate as a cooperating agency.

6.2 Threatened and Endangered Species Consultation

The U.S. Fish and Wildlife Service responded that no Federally-listed or proposed, threatened or endangered species or critical habitat und their jurisdiction are known to occur in the project areas(s) and no further consultation was necessary (letter dated August 5, 2005). The Massachusetts Division of Fisheries & Wildlife, Natural Heritage and Endangered Species Program (NHESP) did not have any concerns about State protected rare species in the project area (letter dated September 16, 2005). NOAA Fisheries determined that restrictions outlined in a separate Section 7 consultation between the Corps and National Marine Fisheries Service (NMFS) on the use of the Massachusetts Bay Disposal Site (MBDS) in a letter dated August 29, 1997 would be adhered to for disposal operations and no further consultation pursuant to Section 7 of the Federal Endangered Species Act (ESA) was required (letter, September 6, 2005).

6.3 Essential Fish Habitat Consultation

The 1996 amendments to the Magnuson-Stevens Fishery Conservation Management Act strengthen the ability of the National Marine Fisheries Service and the New England Fishery Management Council to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. This habitat is termed "essential fish habitat (EFH)", and is broadly defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Managed species listed for the 10' x 10' square of latitude and longitude which includes Boston Harbor are: Atlantic cod, haddock, pollock, whiting, red hake, white hake, winter flounder, yellowtail flounder, windowpane flounder, American plaice, ocean pout, Atlantic halibut, Atlantic sea scallop, Atlantic sea herring, long finned squid, short finned squid, Atlantic butterfish, Atlantic mackerel, summer flounder, scup, black sea bass, surf clam, and bluefin tuna. See Table 6-1. The same species are listed for the 10’ x 10’ square of latitude and longitude which includes the MBDS, except for: pollock, summer flounder, scup, black sea bass, and surf clam. See Table 6-2. Species listed in the MBDS square that are not listed for Boston Harbor include redfish, witch flounder, and monkfish.

TABLE 6-1. **Essential Fish Habitat Species for Boston Harbor, Massachusetts**

SPECIES	EGGS	LARVAE	JUVENILE	ADULTS	SPAWNING ADULTS
Atlantic cod (*Gadus morhua*)	S	S	M,S	M,S	S
Haddock (*Melanogrammus aeglefinus*)	S	S			
Pollock (*Pollachius virens*)	S	S	M,S		
Whiting (*Merluccius bilinearis*)	S	S	M,S	M,S	
Red hake (*Urophycis chuss*)		S	S	S	
White hake (*Urophycis tenuis*)	S	S	S	S	
Winter flounder (*Pseudopleuronectes americanus*)	M,S	M,S	M,S	M,S	M,S
Yellowtail flounder (*Pleuronectes ferruginea*)	S	S	S	S	S
Windowpane flounder (*Scopthalmus aquosus*)	M,S	M,S	M,S	M,S	M,S
American plaice (*Hippoglossoides platessoides*)	S	S	S	S	S
Ocean pout (*Macrozoarces americanus*)			S	S	
Atlantic halibut (*Hippoglossus hippoglossus*)	S	S	S	S	S
Atlantic sea herring (*Clupea harengus*)		S	M,S	M,S	
Bluefish (*Pomatomus saltatrix*)			M,S	M,S	
Atlantic butterfish (*Peprilus triacanthus*)	S	S			
Atlantic mackerel (*Scomber scombrus*)	M,S	M,S	M,S	M,S	

S = seawater salinity zone (salinity > 25%), M = mixing zone (salinity 0.5 to <25%), n/a = no data or lifestage not present in species' reproductive cycle

TABLE 6-2. Essential Fish Habitat Species for the Massachusetts Bay Disposal Site

SPECIES	EGGS	LARVAE	JUVENILE	ADULTS	SPAWNING ADULTS
Atlantic cod (*Gadus morhua*)	S	S	S	S	S
Haddock (*Melanogrammus aeglefinus*)	S	S			
Pollock (*Pollachius virens*)	S	S	S	S	S
Whiting (*Merluccius bilinearis*)	S	S	S	S	S
Red hake (*Urophycis chuss*)		S	S	S	S
White hake (*Urophycis tenuis*)	S	S	S	S	
Winter flounder (*Pseudopleuronectes americanus*)	S	S	S	S	S
Yellowtail flounder (*Pleuronectes ferruginea*)	S	S	S	S	S
Windowpane flounder (*Scopthalmus aquosus*)	S	S	S	S	S
American plaice (*Hippoglossoides platessoides*)	S	S	S	S	S
Ocean pout (*Macrozoarces americanus*)	S	S	S	S	S
Atlantic halibut (*Hippoglossus hippoglossus*)	S	S	S	S	S
Atlantic sea scallop (*Placopecten magellanicus*)	S	S	S	S	S
Atlantic sea herring (*Clupea harengus*)		S	S	S	
Bluefish (*Pomatomus saltatrix*)			M,S	M,S	
Atlantic butterfish (*Peprilus triacanthus*)	S		S	S	
Atlantic mackerel (*Scomber scombrus*)	S	S	S	S	
Scup (*Stenotomus chrysops*)			S		

S = seawater salinity zone (salinity > 25%), M = mixing zone (salinity 0.5 to <25%), n/a = no data or lifestage not present in species' reproductive cycle

Appendix A lists the managed species and their appropriate life stage history for the designated 10' x 10' squares that include Boston Harbor and the MBDS.

The only managed EFH species that may be expected to occur in the dredge area (Boston Harbor) are the: pollock (juveniles), red hake (eggs and larvae), white hake (all life stages), winter flounder (all life stages), windowpane flounder (all life stages), long finned squid (pre-recruits and recruits), short finned squid (pre-recruits and recruits) Atlantic mackerel (eggs, juveniles, and adults), summer flounder (adults), scup (juveniles and adults). The remaining species or life stages are not expected to occur in Boston Harbor due to either incorrect water depths or substrate type.

The only managed EFH species that may be expected at the MBDS, the disposal site for suitable material, are the: pollock (eggs and larvae), whiting (all life stages), red hake (larvae, adults, and spawning adults), white hake (all life stages), redfish (all life stages), witch flounder (all life stages), American plaice (larvae, juveniles and adults), ocean pout (adults), Atlantic halibut (eggs and spawning adults), Atlantic sea scallop (eggs), Atlantic sea herring (juveniles and adults), monkfish (eggs, larvae, juveniles, and adults), long finned squid (both life stages), short finned squid (both life stages), Atlantic mackerel (all life stages), summer flounder (adults), scup (juveniles and adults), and bluefin tuna (juveniles and subadults). The remaining species or life stages are not expected to occur at the MBDS because of improper depths or substrate type, or are not an abundant species.

Although dredging and disposal are expected to occur for approximately two years due to the large amount of material to be dredged, based on lessons learned from the BHNIP and the limited areas of activity, overall impacts to EFH and associated managed species are expected to be temporary and insignificant. As mentioned above, turbidity studies conducted in Boston Harbor showed that the silt from the inner portions of Boston Harbor did not travel far from the point of dredging.

The most vulnerable life stages, such as the eggs and larvae, would be the most affected by direct and indirect dredging and disposal activities. Direct impacts include removal by dredging or burial by disposal, and indirect impacts from entrainment in the dredge and disposal plume. While some mortality of eggs and larvae may be expected, the SSFATE plume model does not show a measurable amount of deposit on potential winter flounder spawning habitat in Winthrop Harbor and Logan flats. Juveniles and adults are expected to be able to escape direct impact from dredging and disposal activities and indirect impacts such as turbidity and loss of food. Benthic animals are expected to begin recolonization the area rapidly, depending on the time of year the construction activities occur. Dredging the silty maintenance material will be conducted with an enclosed bucket to reduce turbidity impacts. Although, the passage of fish into and out of Boston Harbor should not be impeded due to the wide harbor entrance, a fish observer and sonar system will be used between February 15 and June 15 during disposal into the CAD cells to protect migrating anadromous fish.

6.4 Coastal Zone Management Consistency Determination

The Coastal Zone Management (CZM) Act of 1972 established a national program to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations" and to "encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone..." (16 U.S.C. 1452, Sec. 303 (1) and (2)). Section 307 (c)(3)(A) of the CZMA provides that "... any applicant for a required Federal license or permit to conduct an activity, in or outside the coastal zone, affecting any land or water use or natural resource of the coastal zone of that state shall provide ... a certification that the proposed activity complies with the enforceable policies of the state's approved program and that such activity will be conducted in a manner consistent with the program." Similar requirements are included for activities conducted by or funded by a federal agency.

A Federal Consistency Determination will be sent to the Massachusetts Office of Coastal Zone Management for concurrence that the proposed dredging project is consistent to the maximum extent practicable with the policies of the Commonwealth of Massachusetts. The policies that are applicable to this proposed maintenance dredging project and the projects consistency with those policies are as follows:

Habitat Policy #1. - Protect coastal resource areas including salt marshes, shellfish beds, dunes, beaches, barrier beaches, salt ponds, eelgrass beds, and fresh water wetlands for their important role as natural habitats. *The silty maintenance material will be dredged with an enclosed bucket to reduce any potential impacts to shellfish beds. None or very small patches of the other resources exist near the project area.*

Coastal Hazards Policy #2. - Ensure construction in water bodies and contiguous land areas will minimize interference with water circulation and sediment transport. *The proposed dredging activities will not interfere with water circulation in Boston Harbor. No permanent structures are proposed in the body of water. Proposed dredging may increase circulation, if only slightly.*

Coastal Hazards Policy #3. - Ensure that state and federally funded public works projects proposed for location in the coastal zone will not exacerbate existing hazards or damage natural buffers or other natural resources and will not promote growth and development in hazard-prone or buffer areas. *The proposed dredging will improve navigation in Boston Harbor by removing sediment build up that is causing a navigation hazard.*

Ports Policy #1. - Ensure that dredging and disposal of dredged material minimizes adverse effects on water quality, physical processes, marine productivity, and public health. *The material proposed for dredging is within acceptable parameters for disposal in open waters. Dredging of the silty maintenance material will occur with an enclosed bucket to reduce turbidity. A fisheries observer and sonar will be used to protect anadromous fish runs between February 15 and June 15 during disposal into a CAD cell. While dredging, the project will comply with the requirements of the state's surface water quality standards*

Ports Policy #2. - Promote the widest possible public benefit from channel dredging. Ensure that dredging is consistent with marine environmental policies. *The proposed dredging will improve safe navigation in Boston Harbor.*

Ports Policy #3. - Preserve and enhance the capacity of Designated Port Areas (DPAs) to accommodate water-dependent industrial uses, and prevent the exclusion of such uses from tidelands and any other DPA lands over which a state agency exerts control by virtue of ownership, regulatory authority, or other legal jurisdiction. *Portions of the port of Boston are in a DPA. Dredging Boston Harbor will enhance the safety of deep draft vessels transiting to these marine terminals. This will accommodate water-dependent industrial uses.*

6.5 Environmental Compliance

This section describes the Federal laws, regulations and programs that are relevant to the dredging and disposal of maintenance dredged material from Boston Harbor.

Federal Statutes

1. Preservation of Historic and Archeological Data Act of 1974, as amended, 16 U.S.C. 469 et seq.

Compliance: Not applicable; project does not require mitigation of historic or archaeological resources at this time.

2. Clean Air Act, as amended, 42 U.S.C. 7401 et seq.

Compliance: The “general conformity” requirements of Section 17(c)(1) of the Clean Air Act, 42 U.S.C. 7506(x)(1), do not apply to the Boston Harbor maintenance dredging project. Maintenance dredging where no new depths are required, applicable permits are secured, and disposal will be at an approved disposal site satisfies the conformity requirements pursuant to one of the specific exemptions stated in EPA’s regulation 40 CFR 51.8539(c)(ix).

3. Clean Water Act of 1977 (Federal Water Pollution Control Act Amendments of 1972) 33 U.S.C. 1251 et seq.

Compliance: Under Section 401 of the Clean Water Act, any Federal activity that will result in a discharge to waters or wetlands subject to Federal jurisdiction is required to obtain a State Water Quality Certification (WQC) to ensure compliance with State water quality standards. An application shall be filed with the Commonwealth of Massachusetts for a WQC pursuant to Section 401 of the Clean Water Act for the disposal of dredged material into CAD cells within Boston Harbor.

Section 404 of the Clean Water Act governs the disposal of fill, including dredged material into waters of the United States within the three mile territorial sea. This applies to discharges landward of the baseline of the territorial sea and in instances seaward of the baseline when the intent is to fill or nourish beaches. A draft Section 404(b)(1) Evaluation and Compliance Review has been prepared for the disposal of dredged material within Boston Harbor.

4. Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.

Compliance: The U.S. Army Corps of Engineers will complete a Federal consistency determination pursuant to Section 307 of the Coastal Zone Management Act to determine that the proposed project is consistent to the maximum extent possible with the MA Office of Coastal Zone Management program. A summary of that determination is provided in Section 6.4, above.

5. Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.

Compliance: Coordination with the U.S. Fish and Wildlife Service (FWS) and/or National Marine Fisheries Service (NMFS) has yielded no formal consultation requirements pursuant to Section 7 of the Endangered Species Act (see letters dated February 12, 2003 and February 25, 2003).

6. Estuarine Areas Act, 16 U.S.C. 1221 et seq.

Compliance: Not Applicable; this report is not being submitted to Congress.

7. Federal Water Project Recreation Act, as amended, 16 U.S.C. 4601-12 et seq.

Compliance: Public notice of availability to this report to the National Park Service (NPS) and Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

8. Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 et seq.

Compliance: Coordination with the FWS, NMFS, and Massachusetts Department of Marine Fisheries signifies compliance with the Fish and Wildlife Coordination Act. See Section 7.0 above and Appendix C.

9. Land and Water Conservation Fund Act of 1965, as amended, 16 U.S.C. 4601-4 et seq.

Compliance: Public notice of the availability of this report to the National Park Service (NPS) and the Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

10. Marine Protection, Research, and Sanctuaries Act of 1971, as amended, 33 U.S.C. 1401 et seq.

Compliance: Applicable; project involves the transportation or disposal of dredged material in ocean waters pursuant to Sections 102 and 103 of the Act, respectively. No disposal of materials at the MBDS will occur unless they meet the requirements of MPRSA.

11. National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq.

Compliance: Coordination with the State Historic Preservation Office determined that no historic or archaeological resources would be affected by the proposed project (see letter dated March 31, 2003).

12. National Environmental Policy Act of 1969, as amended, 42 U.S.C 4321 et seq.

Compliance: Preparation of this Supplemental Environmental Impact Statement signifies partial compliance with NEPA. Full compliance shall be noted at the time the Record of Decision is issued.

13. Rivers and Harbors Act of 1899, as amended, 33 U.S.C. 401 et seq.

Compliance: No requirements for Corps' projects or programs authorized by Congress. The proposed is pursuant to the Congressionally-approved continuing authority program.

14. Watershed Protection and Flood Prevention Act as amended, 16 U.S.C 1001 et seq.

Compliance: Not applicable, project area is not a watershed protection or flood prevention act area.

15. Wild and Scenic Rivers Act, as amended, 16 U.S.C 1271 et seq.

Compliance: Not applicable, project area is not a Wild or Scenic River.

16. Magnuson-Stevens Act, as amended, 16 U.S.C. 1801 et seq.

Compliance: Coordination with the NOAA Fisheries and preparation of an Essential Fish Habitat (EFH) Assessment signifies compliance with the EFH provisions of the Magnuson-Stevens Act. See Section 6.3 above and Appendix A.

Executive Orders

1. Executive Order 11593, Protection and Enhancement of the Cultural Environment, 13 May 1971.

Compliance: Coordination with the State Historic Preservation Officer signifies compliance. See letter dated September 16, 2005 with a concurrence dated September 22, 2005.

2. Executive Order 11988, Floodplain Management, 24 May 1977 amended by Executive Order 12148, 20 July 1979.

Compliance: Not applicable; project is not located within a floodplain.

3. Executive Order 11990, Protection of Wetlands, 24 May 1977.

Compliance: Not applicable; project does not involve nor impact Federal wetlands.

4. Executive Order 12114, Environmental Effects Abroad of Major Federal Actions, 4 January 1979.

Compliance: Not applicable; project is located within the United States.

5. Executive Order 12898, Environmental Justice, 11 February 1994.

Compliance: Not applicable; project is not expected to have a significant impact on minority or low income population, or any other population in the United States.

6. Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks, 21 April 1997.

Compliance: Not applicable; the project would not create a disproportionate environmental health or safety risk for children.

7. Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, 6 November 2000.

Compliance: Consultation with Indian Tribal Governments, where applicable, and consistent with executive memoranda, DoD Indian policy, and Corps Tribal Policy Principals signifies compliance.

Executive Memorandum

1. Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA, 11 August 1980.

Compliance: Not Applicable; project does not involve our impact agricultural lands.

2. White House Memorandum, Government-to-Government Relations with Indian Tribes, 29 April 1994.

Compliance: Consultation with Federally Recognized Indian Tribes, where appropriate, signifies compliance.

7.0 Public Involvement

7.1 Federal Register/Public Notice

A Notice of Intent (NOI) to prepare a Supplemental Environmental Impact Statement (SEIS) was published in the Federal Register on April 25, 2005. The NOI notifies the public that an EIS will be prepared and allows the public to ask questions about the proposed action. Interested individuals can also be placed on mailing lists for potential meetings and future publications of the SEIS.

A public notice describing the proposed project was released for public comment on June 17, 2005 with a 30-day comment deadline. A request for a public hearing was received from Bosport Docking, LLC in Boston, MA. Conversations with the general manager indicated that a meeting would be adequate to address their concerns about the need for the dredging in the Charles River and potential damage to docks from the dredging operations. A copy of the public notice, corresponding letters, and meeting minutes can be found in Appendix D.

This Draft SEIS and State Notice of Project Change (NPC) are published together to provide an opportunity for public review and comment. A minimum 45-day public comment is provided once a Notice of Availability of the Draft SEIS/NPC is published in the Federal Register. A Final SEIS will be prepared once comments have been received on the Draft SEIS. The Corps will prepare a Record of Decision for publication in the Federal Register not sooner than 30 days after the public release of the FSEIS.

7.2 Technical Working Group Meetings

As with the Boston Harbor Navigation Improvement Project (BHNIP), a Technical Working Group (TWG) was established to assist in the planning and review of the SEIS/Notice of Project Change for this maintenance dredging project, the SEIS for the Boston Harbor Deep Draft Project, and the recently-completed Outer Harbor Maintenance Dredging Project (OHMDP). The initial focus of the TWG was on the upcoming Deep Draft project, but some of those discussions also were relevant to this maintenance dredging project. The TWG is comprised of representatives from Federal, State, and local resource agencies, environmental advocates, scientists, and Port-of-Boston stakeholders. See Table 7-1 for a list of TWG members.

Table 7-1. List of IHMDP Technical Working Group Members

TECHNICAL WORKING GROUP MEMBERS	
Federal Agencies	**Local Agency**
U.S. Environmental Protection Agency	Boston Conservation Commission
National Marine Fisheries Service	**Academia**
U.S. Fish and Wildlife Service	Univ. of Massachusetts - Boston
State Agencies	MIT Sea Grant Program
Coastal Zone Management	**Environmental Groups**
Department of Environmental Protection	The Boston Harbor Association
Division of Marine Fisheries	Save the Harbor/Save the Bay

Five TWG meetings were held during the preparation of the draft SEIS/Notice of Project Change. The first meeting was held June 10, 2003. Agenda items discussed included a description of the proposed project, lessons learned from the previous BHNIP, a review of the scope of work for biological and physical testing, and a review of the physical, chemical and biological sediment testing. Questions were raised during the meeting regarding the scope of biological sampling for the project.

The second TWG meeting was held January 27, 2004. A brief discussion was held on the status of the benthic samples collected in September 2003 from the Federal navigation channels, Massport berths and private berths. The benthic results were posted on the Corps webpage when finalized. A subsurface exploration was initiated to determine the amount of bedrock and ledge that will need to be removed based on the preferred depth alternative. Results of a literature search were presented and TWG members invited to add any other known sources of information not included in the report. The search was used to help identify gaps in data. It was noted that no new fishing data had been collected recently. Corps and Massport were also reminded that a cumulative impact analysis would be needed for the SEIS/NPC.

During the third TWG meeting held on June 22, 2004, TWG members were informed that maintenance material west of Castle Island in the Federal navigation channel was found to be unsuitable for ocean water disposal. Therefore, this material would not be dredged with the rest of the maintenance material in the outer harbor, but will be dredged and disposed when the Inner Harbor Maintenance Dredging Project (IHMDP) proceeds. The literature search and data gap analysis were finalized and the results posted on the Corps website. With this information, a GIS layer showing previously sampled areas for fish, shellfish and benthic organisms were presented and a discussion on a biological sampling program ensued. The discussion ended with the Corps and Massport agreeing to receive more input into a strategy for assessing biological resources in Boston Harbor.

The fourth meeting was held on January 5, 2005. TWG members were updated on the latest schedule for the outer harbor and inner harbor maintenance dredging projects. The biological resource assessment strategy was developed to address the TWG's comments that the proposed biological sampling plan was too limited. To address this issue, the Corps and Massport proposed to use a conservative approach to assess impacts for biological resources, assuming the resources are there unless a physical, chemical or biological parameter would limit the occurrence of the resource.

The fifth meeting was held November 29, 2005. The latest schedule for this Draft SEIS/Notice of Project Change, including permits, was discussed. Members of the TWG were informed of the urgency to expedite review of the permits as funding for the IHMDP project is expected this fiscal year. Concern was raised that preparing a SEIS vs. an EIS was segmenting the project, particularly from a potential public comment perspective. It was explained that the project area and disposal is similar to the original EIS and that the SEIS builds on the lessons learned from the original EIS. Furthermore, ample public comment opportunity exists since the SEIS is being processed as draft and final documents. The cumulative impact section of the SEIS also discusses all of the past, current and foreseeable future Boston Harbor projects. A presentation on lessons learned from the original BHNIP was shown. An environmental window/recommendations were not presented at this time as additional information on biological resources that could affect the recommendations was anticipated. The biological resource studies and the five year monitoring report for the CAD cells will be posted on the Corps web site when they are finalized.

8.0 List of Preparers

U.S. ARMY CORPS OF ENGINEERS

Valerie Cappola: Marine Ecologist, New England District, U.S. Army Corps of Engineers
Education: Ph. D. in Marine, Estuarine and Environmental Sciences from University of Maryland, M.S. in Biology from Texas A&M University, B.S. in Biology from Eckerd College.
Experience: Dr. Cappola is a specialist in benthic marine ecology, and the systematics of crustaceans and cnidarians. After teaching at Salve Regina University in Newport, RI and Emerson College in Boston, MA, she joined the US Army Corps of Engineers. She has spent the past year and half working on environmental assessments (EAs) for dredging projects.
Role in Preparing this SEIS: Dr. Cappola was responsible for the sections on birds, mammals, and threatened, endangered and rare species.

Michael F. Keegan: Project Manager, New England District, U.S. Army Corps of Engineers
Education: B.S. Civil Engineering, Lowell Technological Institute
Experience: Mr. Keegan is a registered professional engineer and a licensed construction supervisor with over 25 years experience in project management directing the evaluation, design, and construction of civil works projects focusing on navigation, flood damage reduction and environmental restoration.
Role in Preparing this SEIS: Mr. Keegan was the project manager for the Boston Harbor Inner Harbor Maintenance Dredging Project. He was responsible for overall project management, development, and implementation of the public outreach program and was a technical reviewer of all sections of the Draft SEIS. Mr. Keegan was also responsible for all coordination efforts with Massport.

Robert Meader: Civil Engineer, New England District, U.S. Army Corps of Engineers
Education: M.C.R.P. Rutgers, The State University, New Brunswick, NJ; B.S. in Civil Engineering, Worcester Polytechnic Institute, Worcester, MA.
Experience: Over thirty years experience with the Corps of Engineers in planning and design of navigation projects, both shallow and deep draft. Most recently, engineering and design for improvement dredging in Boston Harbor and maintenance dredging in Providence Harbor.
Role in Preparing this SEIS: Technical oversight of project design.

Marcos A. Paiva: Archaeologist, New England District, U.S. Army Corps of Engineers
Education: Ph.D. Candidate in Anthropology at Brandeis University, Waltham, MA; M.A. in History/Historical Archaeology from the University of Massachusetts at Boston; B.A. in History (minor in Anthropology) from the University of Massachusetts at Dartmouth.
Experience: Mr. Paiva has over 14 years of experience in addressing cultural resource impact assessments and compliance as a result of Federal projects including civil works, military, Superfund, project operations and work for others. Underwater archaeology has been addressed as part of the Hyannis Harbor Improvement Project, Providence River and Harbor Maintenance Dredging Project, and the Boston Harbor Deep Draft Navigation Dredging Project. Mr. Paiva

was a technical reviewer and contract manager for cultural resources for the Providence River and Harbor EIS as well as the Long Island Sound EIS.
Role in Preparing this SEIS: Mr. Paiva was responsible for the historic and archaeological sections of the SEIS.

Catherine J. Rogers: Ecologist (Regional Expert), New England District, U.S. Army Corps of Engineers
Education: M.S. in Ecological and Evolutionary Biology/Coastal Zone Study from the University of West Florida; B.S. in Plant and Soil Science from the University of Massachusetts, Amherst.
Experience: Ms. Rogers serves as a technical lead in the preparation of NEPA documents; Marine Protection, Research and Sanctuaries Act (MPRSA) and Clean Water Act Section 404 compliance; and other applicable environmental compliance for civil works projects. She has prepared numerous Environmental Assessments and prepared and provided technical review of Environmental Impact Statements for Corps water resources development projects including maintenance and improvement dredging projects, shoreline protection projects and environmental restoration projects for 19 years. Major relevant projects include the Boston Harbor Navigation Improvement Project and the Rhode Island Region Long-Term Dredged Material Disposal Site Evaluation Project.
Role in Preparing this SEIS: Ms. Rogers provided the technical lead on preparation of this SEIS. She also authored subsections of the Affected Environment and Environmental Consequences Section of the SEIS, as well as other sections of the SEIS.

MASSPORT

Deborah Hadden: Deputy Port Director, Properties and Transportation, Massachusetts Port Authority
Education: M.S. in Biology from Northeastern University, B.S. in Biology from Bucknell University
Experience: Ms. Hadden has 20 years of environmental permitting experience including extensive experience preparing Environmental Impact Reports under the Massachusetts Environmental Policy Act and Environmental Impact Statements under the National Environmental Policy Act. For the past nine years, she has served as Massport's project manager for the Boston Harbor Navigation Improvement Project and other harbor dredging projects in coordination with the Army Corps of Engineers. For the past five years, her role at Massport has shifted to focus on maritime property development and management and port transportation and environmental issues in addition to dredging.
Role in Preparing this SEIS: Providing port and maritime industry input and overall technical review.

Stewart Dalzell: Deputy Director, Environmental Planning and Permitting, Massachusetts Port Authority
Education: B.S. Biology, Springfield College
Experience: Mr. Dalzell has over 25 years private and public sector experience in the preparation of federal and state environmental permit documentation. Since 2000, he has served as Deputy Director for Massport where he oversees environmental planning and permitting and mitigation tracking for major Massport aviation, port, commercial development and

infrastructure projects. A focus of many of these projects has been coastal and waterfront issues and mitigation planning associated with port activities and projects along Logan's extensive waterfront.
Role in Preparing this SEIS: Providing environmental management and overall technical review.

Jacquelyn Wilkins: Senior Project Manager, Environmental Planning and Permitting, Massachusetts Port Authority
Education: Working towards an M.S. in Environmental Studies, University of Massachusetts at Lowell; A.B. Geology, Lafayette College
Experience: Ms Wilkins has 27 years of varied public and private sector experience in the environmental arena in Massachusetts, including 5 years as regulator for the Department of Environmental Protection, 11 years as an Environmental Analyst in the Massachusetts Environmental Policy Act (MEPA) Office, 6 years consulting on complex projects requiring various Federal, State, and local; and four+ years managing environmental planning and permitting projects for Massport.
Role in preparing this SEIS: Managing the MEPA Notice of Project Change preparation and coordination with the SEIS.

BATTELLE

Jennifer Field: Principal Research Scientist, Battelle
Education: M.S. in Biological Science from Old Dominion University; B.S. in Biological Science from Florida State University.
Experience: Ms. Field has more than 11 years of experience working on the biology and ecology of marine organisms, including fish, crustaceans, and marine mammals, and five years of experience working on anthropogenic impact studies in the marine environment.
Role in Preparing this SEIS: Ms. Field was the lead contributor of the fish subsection for the Affected Environment.

Roy Kropp: Senior Research Scientist, Battelle
Education: Ph.D. in Zoology from the University of Maryland; M.S. in Biology from the University of Guam; B.S. in Zoology from San Diego State University.
Experience: Dr. Kropp is a specialist in benthic marine ecology, toxicology, and the systematics of crustaceans and mollusks with 21 years of experience. He has served as the principal investigator for or participated in marine environmental surveys in the tropical and boreal Pacific, off the coast of California, in the Gulf of Mexico, along the Atlantic Coast of the United States, and in the Mediterranean. Currently, Dr. Kropp is a Senior Scientist for Benthic Biology for the Massachusetts Water Resources Authority Monitoring Program. Dr. Kropp has analyzed Rhode Island Sound infaunal data and described infaunal communities in a series of reports for the U.S. Army Corps of Engineers (Corps). Since matriculating to the Marine Sciences Laboratory from Battelle's Duxbury facility, Dr. Kropp has directed several toxicological studies involving the testing of marine and freshwater species. He was the technical project manager for the preparation of the Final EIS prepared for the Providence River dredging project by the Corps.
Role in Preparing this SEIS: Dr. Kropp contributed the benthic subsection for the Affected Environment.

Lisa Lefkovitz: Project/Program Manager, Battelle
Education: M.S. in Water Chemistry from the University of Wisconsin; B.S. in Chemistry from Case Western Reserve University
Experience: Ms. Lefkovitz has over 15 years of project management and environmental science experience working with public- and private-sector clients. Her project management experience has included all aspects of dredged material management as well as a variety of multidisciplinary environmental and engineering projects.
Role in Preparing this SEIS: Ms Lefkovitz contributed the sedimentary environment subsection for the Affected Environment.

Stacy Pala: Research Scientist, Battelle
Education: B.A. in Biology, with Chemistry and Russian Minors, Wheaton College, 1994
Coursework in Environmental Risk Analysis and Environmental Toxicology, University of Massachusetts, Boston
Relevant Experience: Ms. Pala has over 11 years of experience in environmental science, including work in biological assessments (BAs) and EAs, environmental microbiology, chemical analyses, and task management.
Role in Preparing EIS: Ms. Pala contributed to the shellfish subsection of the Affected Environment.

EARTHTECH

Joseph Freeman: Senior Program Director, Earth Tech
Education: M.A. in Public Policy from Tufts University; B. A. in Liberal Arts from Goddard College
Experience: Mr. Freeman has more than 23 years experience in the preparation of environmental impact assessment and environmental permitting documentation for major public infrastructure and coastal development projects.
Role in Preparing this SEIS: Mr. Freeman was the lead contributor of the Cumulative Impacts Section and was also the principal author of the MEPA Notice of Project Change.

Jessica Dominguez: Environmental Scientist, Earth Tech
Education: B.S. in Biology-Environmental Science from Colby College**.**
Experience: Ms. Dominguez has more than five years of experience working on project s involving water quality assessment, endangered species management, field identification of flora and fauna species, developmental impact assessment, wetlands monitoring, environmental permitting, and coastal resource management.
Role in Preparing this SEIS: Ms. Dominguez was a supporting author for the Cumulative Impacts Section.

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10.0 Boston Harbor SEIS Acronym List

IHMDP	Boston Harbor Inner Harbor Maintenance Dredging Project
OHMDP	Boston Harbor Outer Harbor Maintenance Dredging Project
BHNIP	Boston Harbor Navigation Improvement Project and Berth Dredging Project
CAD	Confined Aquatic Disposal
CFR	Code of Federal Regulations
cm	Centimeter
Corps	U.S. Army Corps of Engineers
CPUE	Catch per Unit Effort
CSO	Combined Sewer Overflow
CWA	Clean Water Act
Cy	Cubic Yards
CZMA	Coastal Zone Management Act
DAMOS	Disposal Area Monitoring System
DEIS	Draft Environmental Impact Statement
DO	Dissolved Oxygen
EIS	Environmental Impact Statement
ENSR	ENSR, International
ERDC	Engineer Research and Development Center
FEIS	Final Environmental Impact Statement
ft	foot or feet
GLDD	Great Lakes Dredge and Dock Company
LC_{50}	Lethal Concentration (concentration of a substance at which 50% of a group of experimental organisms are killed in a given time)
MA DMF	Massachusetts Department of Marine Fisheries
Massport	Massachusetts Port Authority
MEPA	Massachusetts Environmental Policy Act
MHW	Mean High Water
mi	mile(s)
MLW	Mean Low Water
MLLW	Mean Lower Low Water
mm	Millimeter
MPRSA	Marine Protection Research and Sanctuaries Act
MWRA	Massachusetts Water Resources Authority
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA-Fisheries	National Oceanographic and Atmospheric Administration-Fisheries
NOI	Notice of Intent
NTU	Nephelometric Turbidity Units
OSI	Organism Sediment Index
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
ppm	Parts per Million

REMOTS	Remote Ecological Monitoring of the Seafloor
RPD	Redox (Reduced Oxygen) Potential Discontinuity
SAIC	Science Applications International Corporation, Inc.
STFATE	Short Term Fate Computer Model
TAC	Technical Advisory Committee
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TSS	Total Suspended Solids
TWG	Technical Working Group
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
WRDA	Water Resources Development Act

11.0 Distribution List for DSEIS/MEPA Notice of Project Change

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APPENDICES

Appendix A

Essential Fish Habitat

ESSENTIAL FISH HABITAT

The 1996 amendments to the Magnuson-Stevens Fishery Conservation Management Act strengthen the ability of the National Marine Fisheries Service and the New England Fishery Management Council to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. This habitat is termed "essential fish habitat", and is broadly defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Managed species listed for the 10' x 10' square of latitude and longitude which includes Boston Harbor are: Atlantic cod, haddock, pollock, whiting, red hake, white hake, winter flounder, yellowtail flounder, windowpane flounder, American plaice, ocean pout, Atlantic halibut, Atlantic sea scallop, Atlantic sea herring, long finned squid, short finned squid, Atlantic butterfish, Atlantic mackerel, summer flounder, scup, black sea bass, surf clam, and bluefin tuna. The same species are listed for the 10’ x 10’ square of latitude and longitude which includes the Massachusetts Bay Disposal Site (MBDS), except for: pollock, summer flounder, scup, black sea bass, and surf clam. Species listed in the MBDS square that are not listed for Boston Harbor include redfish, witch flounder, and monkfish.

The following lists the managed species and their appropriate life stage history for the designated 10' x 10' square for Boston Harbor and the MBDS.

Atlantic cod (*Gadus morhua*)

Eggs: Surface waters around the perimeter of the Gulf of Maine, George's Bank, and the eastern portion of the Continental Shelf off southern New England. Generally, the following conditions exist where cod eggs are found: sea surface temperatures below 12^0 C, water depths less than 110 meters, and a salinity range from 32-33‰. Cod eggs are most often observed beginning in the fall, with peaks in the winter and spring.

Larvae: Pelagic waters of the Gulf of Maine, Georges Bank, and the eastern portion of the Continental Shelf off of southern New England. Generally, the following conditions exist where cod larvae found: sea surface temperatures below 10^0 C, water depths from 30 to 70 meters, and a salinity range from 32-33‰. Cod larvae are most often observed in the spring.

Juveniles: Bottom habitats with a substrate of cobble or gravel in the Gulf of Maine, Georges Bank, and the eastern portion of the Continental Shelf off southern New England. Generally, the following conditions exist where cod juveniles found: water temperatures below 20^0 C, water depths from 25 to 75 meters, and a salinity range from 30-35‰.

Adults: Bottom habitats with a substrate of rocks, pebbles, or gravel in the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Delaware Bay. Generally, the following conditions exist where cod adults are found: water temperatures below 10^0 C, water depths from 10 to 150 meters, and a wide range of oceanic salinities.

Spawning Adults: Bottom habitats with a substrate of smooth sand, rocks, pebbles, or gravel in the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Delaware Bay. Generally, the following conditions exist where spawning cod adults are found:

water temperatures below 10^0 C, water depths from 10 to 150 meters, and a wide range of oceanic salinities. Cod are most often observed spawning during fall, winter, and early spring.

Haddock (*Melanogrammus aeglefinus*)

Eggs: Surface waters over Georges Bank southwest to Nantucket Shoals and the coastal areas of the Gulf of Maine. Generally, the following conditions exist where haddock eggs are found: sea surface temperatures below 10^0 C, water depths from 50 to 90 meters, and salinity ranges from 34 – 36‰. Haddock eggs are most often observed during the months from March to May, April being most important.

Larvae: (Just Boston Harbor) Surface waters over Georges Bank southwest to the middle Atlantic south to Delaware Bay. Generally, the following conditions exist where haddock larvae are found: sea surface temperatures below 14^0 C, water depths from 30 to 90 meters, and salinity ranges from 34 – 36‰. Haddock larvae are most often observed during the months from January through July with peaks in April and May.

Pollock (*Pollachius virens*)

Eggs: Pelagic waters of the Gulf of Maine and Georges Bank. Generally, the following conditions exist where pollock eggs are found: sea surface temperatures below 17^0 C, water depths from 30 to 270 meters, and salinity ranges from 32 – 32.8‰. Pollock eggs are most often observed from October through June with peaks from November to February.

Larvae: Pelagic waters of the Gulf of Maine and Georges Bank. Generally, the following conditions exist where pollock larvae are found: sea surface temperatures below 17^0 C, water depths from 10 to 250 meters. Pollock larvae are often observed from September to July with peaks from December to February.

Juveniles: Bottom habitats with aquatic vegetation or a substrate of sand, mud or rocks in the Gulf of Maine and Georges Bank. Generally, the following conditions exist where pollock juveniles are found: water temperatures below 18^0 C, water depths from 0 to 250 meters, and salinities between 29-32‰.

Adults: Bottom habitats in the Gulf of Maine and Georges Bank and hard bottom habitats (including artificial reefs) off southern New England and the middle Atlantic south to New Jersey. Generally, the following conditions exist where pollock adults are found: water temperatures below 14^0 C, water depths from 15 to 365 meters, and salinities between 31-34‰.

Spawning Adults: Bottom habitats with a substrate of hard, stony or rocky bottom in the Gulf of Maine and hard bottom habitats (including artificial reefs) off southern New England and the middle Atlantic south to New Jersey. Generally, the following conditions exist where pollock adults are found: water temperatures below 8^0 C, water depths from 15 to 365 meters, and salinities between 32-32.8‰. Pollock are most often observed spawning during the months September to April with peaks from December to February.

Whiting (*Merluccius bilinearis*)

Eggs: Surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally the following conditions exist where most whiting eggs are found: sea surface temperatures below 20^0 C, water depths between 50 to 150 meters. Whiting eggs are observed all year, with peaks from June through October.

Larvae: Surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally the following conditions exist where most whiting larvae are found: sea surface temperatures below 20^0 C, water depths between 50 to 130 meters. Whiting larvae are observed all year, with peaks from July through September.

Juveniles: Bottom habitats of all substrate types in the Gulf of Maine, on Georges Bank, the Continental Shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where most whiting juveniles are found: water temperatures below 21^0 C, water depths from 20 to 270 meters, and salinities greater than 20‰.

Adults: Bottom habitats of all substrate types in the Gulf of Maine, on Georges Bank, the Continental Shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where most whiting juveniles are found: water temperatures below 21^0 C, water depths from 20 to 270 meters, and salinities greater than 20‰.

Spawning Adults: Bottom habitats of all substrate types in the Gulf of Maine, on Georges Bank, the Continental Shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where most spawning whiting adults are found: water temperatures below 13^0 C and water depths from 30 to 325 meters.

Red hake (*Urophycis chuss*)

Eggs: Surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally the following conditions exist where hake eggs are found: sea surface temperatures below 10^0 C along the inner continental shelf with a salinity less than 25‰. Hake eggs are most often observed during the months from May to November, with peaks in June and July.

Larvae: Surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally the following conditions exist where red hake larvae are found: sea surface temperatures below 19^0 C, water depths less than 200 meters and a salinity greater than 0.5‰. Red hake larvae are most often observed from May through December, with peaks September to October.

Juveniles: Bottom habitats with a substrate of shell fragments, including areas with an abundance of live scallops, in the Gulf of Maine, on Georges Bank, the Continental Shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where red hake juveniles are found: water temperatures below 16° C, depths less than 100 meters and a salinity range from 31 - 33‰.

Adults: Bottom habitats in depressions with a substrate of sand and mud in the Gulf of Maine, on Georges Bank, the Continental Shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where red hake adults are found: water temperatures below 12 ° C, depths from 10 to 130 meters, and a salinity range from 33 - 34‰.

Spawning Adults: Bottom habitats in depressions with a substrate of sand and mud in the Gulf of Maine, the southern edge of Georges Bank, the Continental Shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where spawning red hake adults are found: water temperatures below 10° C, depths less than 100 meters, and salinity less than 25‰. Red hake are most often observed spawning during the months from May – November, with peaks in June and July.

White hake (*Urophycis tenuis*)

Eggs: Surface waters of the Gulf of Maine, Georges Bank, and southern New England. White hake eggs are most often observed in August and September.

Larvae: Pelagic waters of the Gulf of Maine, the southern edge of Georges Bank, and southern New England to the middle Atlantic. White hake larvae are most often observed in May in the mid-Atlantic area and August and September in the Gulf of Maine and Georges Bank.

Juveniles: *Pelagic stage* – Pelagic waters of the Gulf of Maine, the southern edge of Georges Bank, and southern New England to the middle Atlantic. White hake juveniles in the pelagic stage are most often observed from May through September. *Demersal stage* – Bottom habitats with seagrass beds or a substrate of mud or fine-grained sand in the Gulf of Maine, the southern edge of Georges Bank, and southern New England to the middle Atlantic. Generally, the following conditions exist where white hake juveniles are found: water temperatures below 19 ° C and depths from 5 - 225 meter.

Adults: Bottom habitats with a substrate of mud or fine-grained sand in the Gulf of Maine, the southern edge of Georges Bank, and southern New England to the middle Atlantic. Generally, the following conditions exist where white hake adults are found: water temperatures below 14 ° C and depths from 5 - 325 meter.

Spawning Adults: Bottom habitats with a substrate of mud or fine-grained sand in deep water in the Gulf of Maine, the southern edge of Georges Bank, and southern New England to the middle Atlantic. Generally, the following conditions exist where white hake adults are found: water temperatures below 14 °C and depths from 5 - 325 meter. White hake are most often observed spawning during the months April – May in the southern portion of their range and August – September in the northern portion of their range.

Redfish (*Sebastes fasciatus*)

Larvae: Pelagic waters in the Gulf of Maine and southern Georges Bank. Generally, the following conditions exist where redfish larvae are found: sea surface temperatures below 15 ^{o}C and water depths between 50 and 270 meters. Redfish larvae are most often observed from March through October, with a peak in August.

Juveniles: Bottom habitats with a substrate of silt, mud or hard bottom in the Gulf of Maine and on the southern edge of Georges Bank. Generally, the following conditions exist where redfish juveniles are found: water temperatures below 13^{o}C, depths from 25 – 400 meters, and a salinity range from 31 - 34‰.

Adults: Bottom habitats with a substrate of silt, mud or hard bottom in the Gulf of Maine and on the southern edge of Georges Bank. Generally, the following conditions exist where redfish adults are found: water temperatures below 13^{o}C, depths from 50 – 350 meters, and a salinity range from 31 - 34‰.

Spawning Adults: Bottom habitats with a substrate of silt, mud or hard bottom in the Gulf of Maine and on the southern edge of Georges Bank. Generally, the following conditions exist where redfish adults are found: water temperatures below 13^{o}C, depths from 50 – 350 meters, and a salinity range from 31 - 34‰. Redfish females are most often observed spawning (larvae) during the months from April through August.

Witch flounder (*Glyptocephalus cynoglossus*)

Eggs: Surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where witch flounder eggs are found: sea surface temperatures below 13 ^{o}C over deep water with high salinities. Witch flounder eggs are most often observed during the months from March through October.

Larvae: Surface waters to 250 meters in the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where witch flounder larvae are found: sea surface temperatures below 13 ^{o}C over deep water with high salinities. Witch flounder larvae are most often observed from March through November, with peaks in May to July.

Juveniles: Bottom habitats with a fine-grained substrate in the Gulf of Maine and along the outer continental shelf from Georges Bank south to Cape Hatteras. Generally, the following conditions exist where witch flounder juveniles are found: water temperatures below 13 ^{o}C, depths from 50 – 450 meters, although they have been observed as deep as 1500 meters, and a salinity range from 34 - 36‰.

Adults: Bottom habitats with a fine-grained substrate in the Gulf of Maine and along the outer continental shelf from Georges Bank south to Chesapeake Bay. Generally, the following conditions exist where witch flounder adults are found: water temperatures below 13 ^oC, depths from 25 – 300 meters, and a salinity range from 32 - 36‰.

Spawning Adults: Bottom habitats with a fine-grained substrate in the Gulf of Maine and along the outer continental shelf from Georges Bank south to Chesapeake Bay. Generally, the following conditions exist where spawning witch flounder adults are found: water temperatures below 15 ^oC, depths from 25 – 360 meters, and a salinity range from 32 - 36‰. Witch flounder are most often observed spawning during the months from March through November, with peaks in May to August.

<u>Winter flounder (*Pseudopleuronectes americanus*)</u>

Eggs: Bottom habitats with a substrate of sand, muddy sand, mud, and gravel on Georges Bank, the inshore areas of the Gulf of Maine, southern New England, and the middle Atlantic south to the Delaware Bay. Generally, the following conditions exist where winter flounder eggs are found: water temperatures below 10 ^oC, salinities between 10 - 30‰ and water depths less than 5 meters. On Georges Bank, winter flounder eggs are generally found in water less than 8 ^{o} C, and less than 90 meters deep. Winter flounder eggs are often observed from February to June with a peak in April on Georges Bank.

Larvae: Pelagic and bottom waters of Georges Bank, the inshore areas of the Gulf of Maine, southern New England, and the middle Atlantic south to the Delaware Bay. Generally, the following conditions exist where winter flounder larvae are found: sea surface temperatures less than 15^0 C, salinities between 4 - 30‰, and water depths less than six meters. On Georges Bank, winter flounder larvae are generally found in water less than 8 ^{o} C, and less than 90 meters deep. Winter flounder larvae are often observed from March to July with peaks in April and May on Georges Bank.

Juveniles: *Young-of-the-Year*: Bottom habitats with a substrate of mud or fine-grained sand on Georges Bank, the inshore areas of the Gulf of Maine, southern New England and the middle Atlantic south to the Delaware Bay. Generally, the following conditions exist where winter flounder young-of-the-year are found: water temperatures below 28^o C, and depths from 0.1 – 10 meters, and salinities between 5 - 33‰. *Age 1 + Juveniles*: Bottom habitats with a substrate of mud or fine-grained sand on Georges Bank, the inshore areas of the Gulf of Maine, southern New England and the middle Atlantic south to the Delaware Bay. Generally, the following conditions exist where juvenile winter flounder are found: water temperatures below 25^o C, and depths from 1 – 50 meters, and salinities between 10 - 30‰.

Adults: Bottom habitats including estuaries with a substrate of mud, sand and gravel on Georges Bank, the inshore areas of the Gulf of Maine, southern New England and the middle Atlantic south to the Delaware Bay. Generally, the following conditions exist where adult winter flounder are found: water temperatures below 25^o C, and depths from 1 – 100 meters, and salinities between 15 - 33‰.

Spawning Adults: Bottom habitats including estuaries with a substrate of sand, muddy sand, mud, and gravel on Georges Bank, the inshore areas of the Gulf of Maine, southern New England and the middle Atlantic south to the Delaware Bay. Generally, the following conditions exist where spawning adult winter flounder are found: water temperatures below 15^o C, depths less than 6 meters, except on Georges Bank where they spawn as deep as 80 meters, and salinities 5.5 - 36‰. Winter flounder are most often observed spawning during the months of February to June.

<u>Yellowtail flounder (*Pleuronectes ferruginea*)</u>

Eggs: Surface waters of Georges Bank, Massachusetts Bay, Cape Cod Bay, and the southern New England continental shelf south to Delaware Bay. Generally, the following conditions exist where yellowtail eggs are found: sea surface temperatures below 15^0 C, water depths from 30-90 meters and a salinity range from 32.4-33.5‰. Yellowtail flounder eggs are most often observed during the months from mid-March to July, with peaks in April to June in southern New England.

Larvae: Surface waters of Georges Bank, Massachusetts Bay, Cape Cod Bay, the southern New England shelf and throughout the middle Atlantic south to the Chesapeake Bay. Generally, the following conditions exist where yellowtail larvae are found: sea surface temperatures below 17^{0}C, water depths from 10 – 90 meters, and a salinity range from 32.4 – 33.5‰. Yellowtail flounder larvae are most often observed from March through April in the New York bight and from May through July in southern New England and southeastern Georges Bank.

Juveniles: Bottom habitats with a substrate of sand or sand and mud on Georges Bank, the Gulf of Maine, and the southern New England shelf south to Delaware Bay. Generally, the following conditions exist where yellowtail flounder juveniles are found: water temperatures below 15^0 C, depths from 20 to 50 meters and a salinity range from 32.4 – 33.5‰.

Adults: Bottom habitats with a substrate of sand or sand and mud on Georges Bank, the Gulf of Maine, and the southern New England shelf south to Delaware Bay. Generally, the following conditions exist where yellowtail flounder adults are found: water temperatures below 15^0 C, depths from 20 to 50 meters and a salinity range from 32.4 – 33.5‰.

Spawning Adults: Bottom habitats with a substrate of sand or sand and mud on Georges Bank, the Gulf of Maine, and the southern New England shelf south to Delaware Bay. Generally, the following conditions exist where spawning yellowtail flounder adults are found: water temperatures below 17^0 C, depths from 10 to 125 meters and a salinity range from 32.4 – 33.5‰.

<u>Windowpane flounder (*Scopthalmus aquosus*)</u>

Eggs: Surface waters around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where windowpane flounder eggs are found: sea surface temperatures less than 20^0 C, water depths less than 70 meters. Windowpane flounder eggs are often observed from February to November with peaks in May and October in the middle Atlantic and July through August on Georges Bank.

Larvae: Pelagic waters around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where windowpane flounder larvae are found: sea surface temperatures less than 20^0 C, water depths less than 70 meters. Windowpane flounder larvae are often observed from February to November with peaks in May and October in the middle Atlantic and July through August on Georges Bank.

Juveniles: Bottom habitats with a substrate of mud or fine-grained sand around the perimeter of the Gulf of Maine, on Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where windowpane flounder juveniles are found: water temperatures below 25^0 C, water depths from 1 – 100 meters, and a salinity range from 5.5 – 36‰. (Just Boston Harbor)

Adults: Bottom habitats with a substrate of mud or fine-grained sand around the perimeter of the Gulf of Maine, on Georges Bank, southern New England and the middle Atlantic south to the Virginia-North Carolina border. Generally, the following conditions exist where windowpane flounder adults are found: water temperatures below 26.8^0 C, water depths from 1 – 75 meters, and salinities between 5.5 – 36‰. (Just Boston Harbor)

Spawning Adults: Bottom habitats with a substrate of mud or fine-grained sand in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to the Virginia-North Carolina border. Generally, the following conditions exist where spawning windowpane flounder adults are found: water temperatures below 21^0 C, water depths from 1 – 75 meters, and salinities between 5.5 – 36‰. Windowpane flounder are most often observed spawning during the months February – December with a peak in May in the middle Atlantic. (Just Boston Harbor)

American plaice (*Hippoglossoides platessoides*)

Eggs: Surface waters of the Gulf of Maine and Georges Bank. Generally, the following conditions exist where most American plaice eggs are found: sea surface temperatures below 12^0 C, water depths between 30 and 90 meters and a wide range of salinities. American plaice eggs are observed all year in the Gulf of Maine, but only from December through June on Georges Bank, with peaks in both areas in April and May.

Larvae: Surface waters of the Gulf of Maine, Georges Bank and southern New England. Generally, the following conditions exist where most American plaice larvae are found: sea surface temperatures below 14^0 C, water depths between 30 and 130 meters and a wide range of salinities. American plaice larvae are observed between January and August, with peaks in April and May.

Juveniles: Bottom habitats with fine-grained sediments or a substrate of sand or gravel in the Gulf of Maine and Georges Bank. Generally, the following conditions exist where most American plaice juveniles are found: water temperatures below 17^0 C, water depths between 45 and 150 meters, and a wide range of salinities.

Adults: Bottom habitats with fine-grained sediments or a substrate of sand or gravel in the Gulf of Maine and Georges Bank. Generally, the following conditions exist where most American plaice adults are found: water temperatures below 17^0 C, water depths between 45 and 175 meters, and a wide range of salinities.

Spawning Adults: Bottom habitats of all substrate types in the Gulf of Maine and Georges Bank. Generally, the following conditions exist where most spawning American plaice adults are found: water temperatures below 14^0 C, water depths less than 90 meters, and a wide range of salinities. Spawning begins in March and continues through June.

Ocean Pout (*Macrozoarces americanus*)

Eggs: Bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay. Due to low fecundity, relatively few eggs (<4,200) are laid in gelatinous masses, generally in hard bottom sheltered nests, holes, or crevices where they are guarded by either female or both parents. Generally, the following conditions exist where ocean pout eggs are found: water temperatures below 10^0 C, depths less than 50 meters, and a salinity range from 32-34‰. Ocean pout egg development takes two to three months during late fall and winter.

Larvae: Bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay. Larvae are relatively advanced in development and are believed to remain in close proximity to hard bottom nesting areas. Generally, the following conditions exist where ocean pout larvae are found: sea surface temperatures below 10^0 C, depths less than 50 meters, and salinities greater than 25‰. Ocean pout larvae are most often observed from late fall through spring.

Juveniles: Bottom habitats, often smooth bottom near rocks or algae in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay. Generally, the following conditions exist where ocean pout juveniles are found: water temperatures below 14^0 C, depths less than 80 meters, and salinities greater than 25‰.

Adults: Bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay. Generally, the following conditions exit where ocean pout adults are found: water temperatures below 15^0 C, depths less than 110 meters, and a salinity range from 32-34‰.

Spawning Adults: Bottom habitats with a hard bottom substrate, including artificial reefs and shipwrecks, in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay. Generally, the following conditions exist where spawning ocean pout adults are found: water temperatures below 10^0 C, depths less than 50 meters, and a salinity range from 32-34‰. Ocean pout spawn from late summer through early winter, with peaks in September and October.

Atlantic halibut (*Hippoglossus hippoglossus*)

Eggs: Pelagic waters to the sea floor of the Gulf of Maine and Georges Bank. Generally, the following conditions exist where Atlantic halibut eggs are found: water temperatures between 4 and 7^0 C, water depths less than 700 meters, and salinities less than 35‰. Atlantic halibut eggs are observed between late fall and early spring, with peaks in November and December.

Larvae: Surface waters of the Gulf of Maine and Georges Bank. Generally, the following conditions exist where Atlantic halibut larvae are found: salinities between 30 and 35‰.

Juveniles: Bottom habitats with a substrate of sand, gravel, or clay in the Gulf of Maine and Georges Bank. Generally, the following conditions exist where Atlantic halibut juveniles are found: water temperatures above 2^0 C, water depths from 20 - 60 meters.

Adults: Bottom habitats with a substrate of sand, gravel, or clay in the Gulf of Maine and Georges Bank. Generally, the following conditions exist where Atlantic halibut adults are found: water temperatures below 13.6^0 C, water depths from 100 - 700 meters, and salinities between 30.4 – 35.3‰.

Spawning Adults: Bottom habitats with a substrate of soft mud, clay, sand, or gravel in the Gulf of Maine and Georges Bank, as well as rough or rocky bottom locations along the slopes of the outer banks. Generally, the following conditions exist where spawning Atlantic halibut adults are found: water temperatures below 7^0 C, water depths less than 700 meters, and salinities less than 35‰. Atlantic halibut are most often observed spawning between late fall and early spring, with peaks in November and December.

Atlantic sea scallop (*Placopecten magellanicus*)

Eggs: Bottom habitats in the Gulf of Maine, Georges Bank, southern New England the middle Atlantic south to the Virginia-North Carolina border. Eggs are heavier than seawater and remain on the seafloor until they develop into the first free-swimming larval stage. Generally, sea scallop eggs are thought to occur where water temperatures are below 17^0 C. Spawning occurs from May through October, with peaks in May and June in the middle Atlantic area and in September and October on Georges Bank and in Gulf of Maine.

Larvae: Pelagic waters and bottom habitats with a substrate of gravelly sand, shell fragments, and pebbles, or on various red algae, hydroids, amphipod tubes and bryozoans in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to the Virginia-North Carolina border. Generally, the following conditions exist where sea scallop larvae are found: sea surface temperatures below 18^0 C and salinities between 16.9‰ and 30‰.

Juveniles: Bottom habitats with a substrate of cobble, shells and silt in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to the Virginia-North Carolina border that support the highest densities of sea scallops. Generally, the following conditions exist where most sea scallop juveniles are found: water temperatures below 15^0 C, and water depths from 18-110 meters and salinities above 16.5‰.

Adults: Bottom habitats with a substrate of cobble, shells, coarse/gravelly sand, and sand in the Gulf of Maine, Georges Bank, southern New England and middle Atlantic south to the Virginia-North Carolina border that support the highest densities of sea scallops. Generally, the following conditions exist where most sea scallop adults are found: water temperatures below 21^0 C, water depths from 18-110 meters, and salinities above 16.5‰.

Spawning Adults: Bottom habitats with a substrate of cobble, shells, coarse/gravelly sand, and sand in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to the Virginia-North Carolina border that support the highest densities of sea scallop adults are found: water temperatures below 16^0 C, depths from 18-110 meters, and salinities above 16.5‰. Spawning occurs from May through October, with peaks in May and June in the middle Atlantic area, and in September and October on Georges Bank and in the Gulf of Maine.

Atlantic sea herring (*Clupea harengus*)

Larvae: Pelagic waters in the Gulf of Maine, Georges Bank, and southern New England that comprise 90% of the observed range of Atlantic herring larvae. Generally, the following conditions exist where Atlantic herring larvae are found: sea surface temperatures below 16^0 C, water depths from 50 - 90 meters, and salinities around 32‰. Atlantic herring larvae are observed between August and April, with peaks from September through November.

Juveniles: Pelagic waters and bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where Atlantic herring juveniles are found: water temperatures below 10^0 C, water depths from 15 - 135 meters, and salinity range from 26 to 32‰.

Adults: Pelagic waters and bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where Atlantic herring adults are found: water temperatures below 10^0 C, water depths from 20 - 130 meters, and salinities above 28‰.

Spawning Adults: Bottom habitats with a substrate of gravel, sand, cobble and shell fragments, but also on aquatic macrophytes, in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay. Generally, the following conditions exist where spawning Atlantic herring adults are found: water temperatures below 15^0 C, water depths from 20 - 80 meters, and salinity range from 32 to 33‰. Herring eggs are spawned in areas of well-mixed water, with tidal currents between 1.5 and 3.0 knots. Atlantic herring are most often observed spawning during the months from July through November.

Monkfish (*Lophius americanus*)

Eggs: Surface waters of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where monkfish egg veils are found: sea surface temperatures below 18^0 C and water depths from 15 –

1000 meters. Monkfish egg veils are most often observed during the months from March to September.

Larvae: Pelagic waters of the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where monkfish larvae are found: water temperatures 15^0 C and water depths from 25 – 1000 meters. Monkfish larvae are most often observed during the months from March to September.

Juveniles: Bottom habitats with substrates of a sand-shell mix, algae covered rocks, hard sand, pebbly gravel, or mud along the outer continental shelf in the middle Atlantic, the mid-shelf off southern New England, and all areas of the Gulf of Maine. Generally, the following conditions exist where monkfish juveniles are found: water temperatures below 13^0 C , depths from 25 – 200 meters, and a salinity range from 29.9 – 36.7‰.

Adults: Bottom habitats with substrates of a sand-shell mix, algae covered rocks, hard sand, pebbly gravel, or mud along the outer continental shelf in the middle Atlantic, the mid-shelf off southern New England, along the outer perimeter of Georges Bank, and all areas of the Gulf of Maine. Generally, the following conditions exist where monkfish adults are found: water temperatures below 15^0 C , depths from 25 – 200 meters, and a salinity range from 29.9 – 36.7‰.

Spawning Adults: Bottom habitats with substrates of a sand-shell mix, algae covered rocks, hard sand, pebbly gravel, or mud along the outer continental shelf in the middle Atlantic, the mid-shelf off southern New England, along the outer perimeter of Georges Bank, and all areas of the Gulf of Maine. Generally, the following conditions exist where spawning monkfish adults are found: water temperatures below 13^0 C , depths from 25 – 200 meters, and a salinity range from 29.9 – 36.7‰. Monkfish are observed spawning most often during the months from February to August.

Long finned squid (*Loligo pealei*)

Juveniles: Pelagic waters found over the continental shelf, from the Gulf of Maine through Cape Hatteras in areas that encompass the highest 75% of the catches where juvenile squid were collected. Generally, juvenile long finned squid are collected from shore to 700 feet and in temperatures between 4^0 F and 27^0 F.

Adults: Pelagic waters found over the continental shelf, from the Gulf of Maine through Cape Hatteras in areas that encompass the highest 75% of the catches where adult squid were collected. Generally, adult long finned squid are collected from shore to 1000 feet and in temperatures between 39^0 F and 81^0 F.

Short finned squid (*Illex illecebrosus*)

Juveniles: Pelagic waters found over the continental shelf, from the Gulf of Maine through Cape Hatteras in areas that encompass the highest 75% of the catches where juvenile squid were collected. Generally, juvenile short finned squid are collected from shore to 600 feet and in temperatures between 36^0 F and 73^0 F.

Adults: Pelagic waters found over the continental shelf, from the Gulf of Maine through Cape Hatteras in areas that encompass the highest 75% of the catches where adult squid were collected. Generally, adult short finned squid are collected from shore to 600 feet and in temperatures between 39^0 F and 66^0 F.

Atlantic butterfish (*Peprilus triacanthus*)

Eggs: Pelagic waters found over the continental shelf, from the Gulf of Maine through Cape Hatteras in areas that encompass the highest 75% of the catches where butterfish eggs were collected. The “mixing” and/or “seawater” portions of all the estuaries where butterfish are “common”, “abundant”, or “highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. Generally, butterfish eggs are collected from shore to 6000 feet and in temperatures between 52^0 F and 63^0 F.

Larvae: Pelagic waters found over the continental shelf, from the Gulf of Maine through Cape Hatteras in areas that encompass the highest 75% of the catches where butterfish larvae were collected. The “mixing” and/or “seawater” portions of all the estuaries where butterfish are “common”, “abundant”, or “highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. Generally, butterfish larvae are collected from 33 feet to 6000 feet and in temperatures between 48^0 F and 66^0 F.

Juveniles: Pelagic waters found over the continental shelf, from the Gulf of Maine through Cape Hatteras in areas that encompass the highest 75% of the catches where butterfish juvenile were collected. The “mixing” and/or “seawater” portions of all the estuaries where butterfish are “common”, “abundant”, or “highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. Generally, butterfish larvae are collected from 33 feet to 1200 feet and in temperatures between 37^0 F and 82^0 F.

Adults: Pelagic waters found over the continental shelf, from the Gulf of Maine through Cape Hatteras in areas that encompass the highest 75% of the catches where butterfish adults were collected. The “mixing” and/or “seawater” portions of all the estuaries where butterfish are “common”, “abundant”, or “highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. Generally, adult butterfish are collected in depths from 33 feet to 1200 feet and in temperatures between 37^0F and 82^0F.

Atlantic mackerel (*Scomber scombrus*)

Eggs: EFH is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine through Cape Hatteras, North Carolina; in areas that encompass the highest 75% of the catch where Atlantic mackerel eggs were collected. EFH is also the "mixing" and/or "seawater" portions of all the estuaries where Atlantic mackerel are "common", "abundant", or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. Generally, Atlantic mackerel eggs are collected from shore to 50 feet and temperatures between 41^0 F and 73^0 F.

Larvae: EFH is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine through Cape Hatteras, North Carolina; in areas that encompass the highest 75% of the catch where juvenile Atlantic mackerel were collected in NEFSC trawl surveys. EFH is also the "mixing" and/or "seawater" portions of all the estuaries where Atlantic mackerel are "common", "abundant", or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. Generally, Atlantic mackerel larvae are collected in depths between 33 feet to 425 feet and temperatures between 43^0 F and 72^0 F.

Juveniles: EFH is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine through Cape Hatteras, North Carolina; in areas that encompass the highest 75% of the catch where juvenile Atlantic mackerel were collected in NEFSC trawl surveys. EFH is also the "mixing" and/or "seawater" portions of all the estuaries where Atlantic mackerel are "common", "abundant", or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. Generally, juvenile Atlantic mackerel are collected from shore to 1,050 feet and temperatures between 39^0 F and 72^0 F.

Adults: EFH is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine through Cape Hatteras, North Carolina; in areas that encompass the highest 75% of the catch where adult Atlantic mackerel were collected in NEFSC trawl surveys. EFH is also the "mixing" and/or "seawater" portions of all the estuaries where Atlantic mackerel are "common", "abundant", or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. Generally, adult Atlantic mackerel are collected from shore to 1,250 feet and temperatures between 39^0 F and 61^0 F.

Summer flounder (*Paralicthys dentatus*)

Adults: North of Cape Hatteras, EFH is the demersal waters over the continental shelf from the Gulf of Maine to Cape Hatteras, in the highest 90% of the area where adult summer flounder were collected. Generally, summer flounder inhabit shallow coastal and estuarine waters during the warmer months and move offshore on the outer continental shelf at depths of 500 feet in colder months. Inshore, EFH is the estuaries where summer flounder were identified as being common, abundant, or highly abundant for the “mixing” and “seawater” salinity zones.

Scup (*Stenotomus chrysops*)

Juveniles: North of Cape Hatteras, EFH is the demersal waters over the continental shelf from the Gulf of Maine to Cape Hatteras, in the highest 90% of the area where juvenile scup were collected. Generally, juvenile scup are found in water temperatures greater than 45^0 F and where salinities are greater than 15 ppt. Inshore, EFH is the estuaries where scup were identified as being common, abundant, or highly abundant for the “mixing” and “seawater” salinity zones. Juvenile scup are generally found in water temperatures greater than 45^0 F and where salinities are greater than 15 ppt. Juvenile scup, in general during the summer and spring are found in estuaries and bays between Virginia and Massachusetts. They are found in association with various sands, mud, mussel and eelgrass bed type substrates.

Adults: North of Cape Hatteras, EFH is the demersal waters over the continental shelf from the Gulf of Maine to Cape Hatteras, in the highest 90% of the area where adult scup were collected. Wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 45^0 F. Inshore, EFH is the estuaries where scup were identified as being common, abundant, or highly abundant for the "mixing" and "seawater" salinity zones.

Black sea bass (*Centropristus striata*)

Juveniles: North of Cape Hatteras, EFH is the demersal waters over the continental shelf from the Gulf of Maine to Cape Hatteras, in the highest 90% of the area where juvenile black sea bass were collected. Temperature preference is for areas warmer than 6^0 F with salinities greater than 18 ppt. Juvenile black sea bass are found in association with rough bottom, shellfish, and eelgrass beds, man-made structures in sandy-shelly areas; offshore clam beds and shell patches may also be used during the winter. They are found in coastal areas between Massachusetts and Virginia, but they winter offshore from New Jersey and south. Inshore, EFH is the estuaries where black sea bass were identified as being common, abundant, or highly abundant for the "mixing" and "seawater" salinity zones. Juveniles are found in the estuaries in the summer and spring.

Adults: North of Cape Hatteras, EFH is the demersal waters over the continental shelf from the Gulf of Maine to Cape Hatteras, in the highest 90% of the area where adult black sea bass were collected. Wintering adults (November through April) are usually offshore, south of New York to North Carolina. Temperatures above 6^0 F seem to be the minimum requirements. Structured habitats (natural and man-made), sand and shell are the substrate preference. Inshore, EFH is the estuaries where adult black sea bass were identified as being common, abundant, or highly abundant for the "mixing" and "seawater" salinity zones. Black sea bass are generally found in estuaries from May through October.

Surf clam (*Spisula solidissima*)

Juveniles and adults: Throughout the substrate to a depth of three feet within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of the area where surf clams were caught. Surf clams generally occur from the beach zone to depth of about 200 feet, but beyond about 125 feet abundance is low.

Bluefin tuna (*Thunnus thynnus*)

Juveniles and subadults: All inshore and pelagic surface waters warmer than 12^0 C of the Gulf of Maine and Cape Cod Bay from Cape Ann, east including waters of the Great South Channel; continuing south to and including Nantucket Shoals to off Cape Hatteras. In pelagic surface waters warmer than 12^0 C between the 25 to 200 meter isobaths.

Appendix B

List of Coastal and Marine Birds in Boston Harbor and Massachusetts Bay

The following is a summary and list of birds that may occur in the project area:

Pelagic birds - Several species of pelagic birds have been identified in the Boston Harbor area, including Wilson's storm-petrel, common murre, the common loon and red-throated loon. These birds are classified as generally open ocean birds during the winter in tropical seas and do not come near the coast except when nesting or breeding in the spring and summer. Prey for pelagic birds include those organisms that may be collected in the open ocean waters, including fish, crustaceans, shellfish, and plankton. Foraging strategies (i.e., feeding techniques) vary from skimming over the surface and plucking small organisms from the water, to diving to great depths for extended periods to gather fish, shrimp, or benthic organisms such as crabs and shellfish. The common loon has been documented as being caught in fishing nets at 200 ft below the water's surface.

Shorebirds - Shorebirds found in the Boston Harbor area not only nest on coastal shore areas, but are unique in that they also forage in these shoreline areas. Shorebirds inhabit coastlines, open beaches, tidal flats, and marshes. The shorebirds in the Boston Harbor area at one time included the piping plover, but it has not been recorded in the area since 1983. Oystercatchers are large, conspicuous birds that were hunted to near-extinction along the Atlantic Coast. Given total protection, they have once again become numerous and now nest in numbers as far north as Massachusetts, where just a few years ago they were very rare. American oystercatchers nest on the Boston Harbor Islands. Shorebirds in general run along the sand or mud and stop to probe the substrate for worms, snails, or small crustaceans living in the substrate. Besides the American oystercatchers, migrating shorebirds, such as black-bellied plovers, semipalmated plovers, greater yellowlegs, lesser yellowlegs, whimbrels, ruddy turnstones, purple sandpipers, sanderlings, semipalmated sandpipers, western sandpipers, and white-rumped sandpipers, have been detected on 16 of the Boston Harbor Islands (Paton *et al*., 2005). These birds tend to feed by sight, preying upon oysters, clams, and mussels or probe for marine worms and other food items in the intertidal zone.

Waterfowl - Many different waterfowl species have been identified and recorded in Boston Harbor area, including bufflehead ducks, the common goldeneye, hooded- and red-breasted merganser, the ruddy duck, the American black duck, the greater scaup, gadwall, Canada goose, brant goose, canvasback, common eider, harlequin duck, surf scoter, white-winged scoter and black scoter. Waterfowl are migratory and spend the majority of the time on the water searching for food such as invertebrates, plants, and small fish. Most of these species breed in coastal waters of northern Canada and winter along the Atlantic coast and have been recorded in the Boston Harbor area. Waterfowl come ashore to breed in inland regions or along the coastlines. Many of these species have been observed diving and swimming at great depths underwater for prey. Diving ducks, such as scaup, can dive to 25 feet to forage for clams, invertebrates, fish, and underwater plants. Sea ducks, such as scoters and eiders, have been observed diving to depths over 100 feet to feed on shellfish such as mussels and crustaceans.

Colonial Water Birds - This category of birds is characterized by the colonies of nests that they build along the coasts. Colonial water birds generally inhabit sandy or rocky islands, coastal beaches, salt marshes, bays, and estuaries. These birds have a variety of feeding techniques ranging from wading through the water grabbing fish and invertebrates to hovering over the water surface and diving into the water to catch fish. Most of the colonial water birds feed in the coastal areas with shallow water depths in search small fish. The diet of most coastal water birds includes fish, various crustaceans, mollusks, and plankton. Several colonial water birds have been observed in the coastal areas of Boston Harbor, including the common tern, least tern, sooty shearwater, northern gannet, double-crested cormorant, great cormorant, great blue heron, green heron, great egret, snowy egret, black crowned night heron, Bonaparte's gull, herring gull, laughing gull, great black-backed gull, ring-billed gull, blacked-legged kittiwake, and razor bill.

Raptors - Raptors are birds of prey that are classified as hunting birds that search for food while in flight. Their diet may consist of fish, other birds, and even small mammals. The bald eagle and peregrine falcon are two examples of raptors that can be observed in the Boston Harbor area. These birds generally nest and perch in the upland habitat of tall trees to survey their area and use the shoreline and open ocean for feeding. The bald eagle is listed threatened on the Federal list and both birds are listed as endangered on the state list. They are discussed in Section 3.5.6.

Marsh Birds - Marsh birds are found in shallow estuaries, coastal bays, and marshes where they feed and breed. Examples of marsh birds observed in the coastal areas of the Boston Harbor area include the horned grebe, red-necked grebe, mute swan, pie-billed grebe, eared grebe, and American bittern. Many of these species move to the coastal areas during the fall and winter. Marsh birds exhibit a variety of feeding techniques, including swimming and diving or wading and grabbing prey. Diets for these birds generally consist of fish, crustaceans, and aquatic plants. Marsh birds are also common in freshwater ponds and rivers.

Table B-1. List of Coastal and Marine Birds Recorded in the Boston Harbor and Massachusetts Bay Areas

Common Name	Scientific Name	Classification	Habitat	Prey	Feeding Technique	Status
Common Loon	*Gavia immer*	Pelagic	Shoreline in spring to breed and nest; in winter, open ocean and bays along coast from Maine to Texas	Principal food source is fish, also shellfish, frogs, aquatic insects	Dives deeply in pursuit of prey; have been caught in nets as much as 200 ft below the water's surface	Species of Special Concern in Massachusetts
Red throated Loon	*Gavia stellata*	Pelagic	Winters along ocean coast during migration; breeds mostly on fresh water	Small or medium sized fish (cod, herring, sprat, sculpins); occasionally crustaceans, mollusks, frogs, fish spawn and insects	Dives recorded at 7–30 ft and average for 1 minute. Prefer clear water for foraging and don't fish at night	No special status

Wilson's Storm-petrel	*Oceanites oceanicus*	Pelagic	Offshore waters	Feeds on small crustaceans, fish and oil from carcasses	Picks prey from the surface of the water while hovering	No special status
Common Murre	*Uria aalge*	Pelagic	Migrate along the coast in the fall to areas where winter food is plentiful	Feed on fish, squid, krill	Dive by flapping their half-open wings, as if flying underwater. Dives to 100 m are common	No special status
Ruddy turnstone	*Arenaria interpres*	Shorebird	Winters on coasts; mudflats, sandbars, sandy or muddy shores, beaches and rocky coasts	Aquatic invertebrates and insects	Uses bill to open barnacles, dig holes, and flip aside stones, shells, and seaweed in pursuit of food	No special status
Sander-Ling	*Calidris alba*	Shorebird	During migration and in winter: Sandy ocean beaches, mudflats, sandy edges of inland lakes and rivers	Small crustaceans and mollusks	As a wave comes roaring in, the birds run up on the beach just ahead of the breaker, then sprint after the retreating water to feed on exposed organisms	No special status
White rumped sandpiper	*Calidris fuscicollis*	Shorebird	During migration, found in mudflats, flooded fields, shallow marshes, beaches, sandbars	Insects, marine worms, mollusks, crustaceans, leaches, seeds, and vegetation	Picks food from the ground and by methodically probes the sediments with its bill	No special status
Purple sandpiper	*Calidris maritime*	Shorebird	Rocks in coastal areas	Insects, small mollusks, seeds, berries, and algae	Forages for food by picking from the surface or probing sediment with	No special status

					bill	
Semi-palmated sandpiper	*Calidris pusilla*	Shorebird	Winters on and migrates along coastal beaches, mudflats and salt marshes	Aquatic invertebrates and seeds	Picking up food by sight	No special status
Semi-palmated plover	*Charadrius semi-palmatus*	Shorebird	During migration and in the winter it can be found on mudflats, salt marshes and lakeshores	Crustaceans and mollusks	Forages from the surface, running and scanning for food in short bursts	No special status
Whimbrel	*Numenius phaeopus*	Shorebird	Winters on coastal marshes, prairies, shores, and mud flats	Feeds on crabs, shrimps, mollusks, and worms	Probe deeply into mud with bill, may also pick off food found on the surface	No special status
Black bellied plover	*Pluvialis squatarola*	Shorebird	Winters on the beaches, mudflats, and coastal marshes	Small crabs, worms, mollusks, and crustaceans.	Forages for food by run, stop and peck	No special status
Lesser yellowlegs	*Tringa flavipes*	Shorebird	In the winter can be found along the shores of lakes and rivers, in marshy ponds and in coastal marshes and mudflats	Aquatic invertebrates and terrestrial insects, also small fish	Forage by pecking and grabbing up prey	No special status
Greater yellowlegs	*Tringa melanoleuca*	Shorebird	Marshes, mudflats, and flooded fields	Small fish, aquatic and terrestrial invertebrates, and berries	Forages by probing its bill into the substrate, but also skims the surface	No special status
American Oystercatcher	*Haematopus palliatus*	Shorebird	Coastal waters	Marine invertebrates (mollusks, crabs and worms), and	Probes the sand, rocks, and other substrates in the coastal	No special status

				occasionally fish	waters	
Bufflehead	*Bucephala albeola*	Waterfowl	Winters on salt bays and estuaries	Freshwater and saltwater aquatic invertebrates (insects, crustaceans, mollusks)	Feed in open, shallow water; dives for food and swallows while underwater	No special status
Common Goldeneye	*Bucephala clangula*	Waterfowl	Winters on coastal bays and estuaries	Mollusks, aquatic plants and insects	Dives for prey	No special status
Hooded Merganser	*Lophodytes cucullatus*	Waterfowl	Winters on coastal marshes and inlets	Small fish, frogs, aquatic insects	Dives for fish in long, rapid, underwater dives	No special status
Red-breasted Merganser	*Mergus serrator*	Waterfowl	Winters mainly on salt water	Fish	Swift, underwater dives	No special status
Ruddy Duck	*Oxyura jamaicensis*	Waterfowl	Winters on marshes and in shallow coastal bays	Pondweeds and other aquatic plants, midge larvae	Surface diver; excellent underwater swimmer; strains bottom material through bill	No special status
American Black Duck	*Anas rubripes*	Waterfowl	Marshes, lakes, streams, coastal mudflats, estuaries. Outside of breeding season, lives on open lagoons and on the coast, even in rough sea waters	Aquatic plants, also invertebrates (insects, mollusks, crustaceans)	Grazing, probing, dabbling for prey; occasionally dives	No special status
Gadwall	*Anas strepera*	Waterfowl	Lakes, reservoirs and estuaries	Aquatic vegetation and invertebrates	Dabbles for prey	No special status
Greater Scaup	*Aythya marila*	Waterfowl	Brackish lakes, bays, and ponds; in winter, often on salt water bays and estuaries of the Atlantic coast	Green plant matter, seeds, mollusks	Grazing and probing for prey; dives for mollusks	No special status
Canvasback	*Aythya valisineria*	Waterfowl	Bays and estuaries in the winter	Aquatic vegetation and invertebrates	Dives for prey	No special status
Brant Goose	*Branta bernicla*	Waterfowl	Saltwater bays and	Submerged vegetation	Feed during low tide, pull plants up	No special status

			estuaries in the winter		from bottom	
Canada Goose	*Branta canadensis*	Waterfowl	Usually inland but sometimes in coastal waters, particularly in spring and fall	Plants	Grazing and dabbling for prey	No special status
Common Eider	*Somateria mollissima*	Waterfowl	Rocky coasts; breeds from Canada to Massachusetts; winters south to Long Island; Most sea going of all waterfowl, never leaving the salt water	Mussels and other shellfish	Dives for prey	No special status
Harlequin Duck	*Histrionicus histrionicus*	Waterfowl	Rocky wave-lashed coasts and jetties in winter; prefers the rugged seacoast	Loose snails, limpets, barnacles, small shrimp, crabs, small fish	Diving for fish or pulling prey off rocks	No special status
Surf Scoter	*Melanitta perspicillata*	Waterfowl	Winters almost entirely on the ocean and in large coastal bays	Mollusks and crustaceans	Diving for food	No special status
White-winged Scoter	*Melanitta fusca*	Waterfowl	Winters mainly on ocean and large coastal bays	Mollusks, crabs, starfish, sea urchin, some fish	Dives for mussels at depths of 15-40 ft	No special status
Black Scoter "Common Scoter"	*Melanitta nigra*	Waterfowl	Winters on ocean and in large salt bays	Mussels and other mollusks, barnacles chitons, limpets	Feeds off rocks and reefs	No special status
Common Tern	*Sterna hirundo*	Colonial water bird	Sandy or rocky islands, sand dunes or barrier beaches; breeds along Atlantic coastline	Primarily sand lance (up to 22 cm) but also other small fish, crustaceans, invertebrates	Feeds close to shore in water less than 15 inches deep; sometimes in deeper water over schools of predatory fish; dives and dips for prey	Species of special concern in Massachusetts
Least Tern	*Sterna*	Colonial	Coastal beaches	Fish less than	Hover, dive,	Species of

	antillarum	water bird	and barrier islands	8-94 cm; minnows, sand lance, herring, hake	skim the surface of the water	special concern in Massachusetts
Sooty Shearwater	*Puffinus griseus*	Colonial water bird	Open ocean; arrive on east coast in May as part of great migration; one of most abundant birds in the world	Fish	Dives from surface and swims underwater with wings	No special status
Northern Gannet	*Morus bassanus*	Colonial water bird	Open seas	Fish	Dives into sea after fish, sometimes plunging headlong from heights as great as 50 ft or more	No special status
Double-crested Cormorant	*Phalacrocorax auritus*	Colonial water bird	Coastlines; marine and inland waters	Fish, crustaceans, amphibians from fresh water	Swims low in water to feed; dives and catches their prey underwater	No special status
Great Cormorant	*Phalacrocorax carbo*	Colonial water bird	Sea cliffs, rocky coasts, and inshore waters; winters from Maine to New Jersey	Fish; in coastal waters during breeding season, herring and eel	Dives for fish	No special status
Great Blue Heron (Blue form)	*Ardea herodias*	Colonial water bird	Lakes, ponds, rivers, marshes	Fish or frogs primarily; occasionally small mammals, reptiles, and birds	Fishes day and night but prefer dawn and dusk; wades in shallow water and spears the food	No special status
Green Heron	*Butorides virescens*	Colonial water bird	Marshes	Food consists Primarily of fish and insects but also crustaceans, mollusks, other invertebrates, amphibians and reptiles	Seizes the prey with a jab of its bill	No special status
Great Egret	*Casmerodius albus*	Colonial water bird	Freshwater and salt marshes, tidal flats, nests in colonies	Fish, frogs, snakes, crayfish	Wades in shallow water and spears the prey	No special status
Snowy Egret	*Egretta thula*	Colonial water bird	Marshes, swamps, ponds,	Fishes, shrimp, crayfish,	Use one foot to stir up the	No special status

			lakes, shallow coastal areas and tidal flats; occasionally found in dry fields	fiddler crabs, snakes, snails, aquatic and terrestrial insects, small lizards, young frogs and aquatic vegetation	bottom, flushing prey into view. Will also hover, then drop to the water to catch prey in their bills	
Black Crowned Night Heron	*Nycticorax nycticorax*	Colonial water bird	Wooded swamps, coastal dune forests, vegetated dredged material islands scrub thickets, or mixed phragmites marshes	Fish, amphibians, reptiles, crayfish, mussels, dragonflies and nymphs, and small rodents	Forages, waits motionless for prey	No special status
Glossy Ibis	*Plegadis falcinellus*	Colonial water bird	Marshy lakeshores and coastal lagoons	Aquatic invertebrates, insects, and snakes	Probes mud and silt with its bill looking for prey	No special status
Willet	*Catoptro-phorus sem-palmatus*	Colonial water bird	Coastal marshes and beaches and mudflats	Aquatic insects, marine worms, small fishes, small crustaceans and mollusks; occasionally seeds and grasses	Forages in mudflats, intertidal areas, and shallow marsh waters; snatches up food from the surface or the water or it probes in the mud with its long bill	No special status
Bonaparte's Gull	*Larus philadelphia*	Colonial water bird	Ocean bays, coastal waters, islands, and lakes	Fish, crustaceans, snails, marine worms	Feed by dipping to the surface of the water. Occasionally they drop into the water, take a few deep strokes, then glide to the surface	No special status
Herring Gull	*Larus argentatus*	Colonial water bird	Common in all aquatic habitats	Aquatic and marine animals, clams, shellfish	Scavenger	No special status
Great Black-	*Larus marinus*	Colonial	Coastal	Anything	Scavenger	No special

backed Gull		water bird	beaches, estuaries, lagoons	smaller than itself, including, small ducks, fish, shellfish		status
Laughing Gull	*Larus atricilla*	Colonial water bird	Salt marshes, bays, estuaries; very rare inland	Insects, fish, shellfish, crabs	Carnivore, scavenger, dives for prey	No special status
Ring-billed Gull	*Larus delawarensis*	Colonial water bird	Lakes and rivers; many move to salt water in winter	Fish, small mammals and rodents	Scavenger	No special status
Black-legged Kittiwake	*Rissa tridactyla*	Colonial water bird	Cliffs and seacoasts; generally spends the entire winter on the open ocean	Small fish and plankton	Only gull that occasionally dives and swims underwater to capture food	No special status
Razorbill	*Alca torda*	Colonial water bird	Coastal waters	Fish, shrimp, and squid	Very adept at diving and have been caught in gill nets as deep as 60 ft	No special status
Bald Eagle	*Haliaeetus leucocephalus*	Raptor	Coastal areas, estuaries, large inland waterways; overwintering along the Atlantic coastlines and islands	Fish, other birds (waterfowl and seabirds), small mammals, carrion	Swooping from a perch or by coursing low over the water and dropping straight down when a fish is spotted	Federal and State listed as threatened
Horned Grebe	*Podiceps auritus*	Marsh bird	Population moves to coast in fall; once on wintering grounds, they seldom fly	Insects, crustaceans, small fish; on wintering grounds, mollusks are also consumed	Excellent swimmer and diver; during dives it may stay submerged for up to three minutes and travel 490-660 ft horizontally in that time	No special status
Red-necked Grebe	*Podiceps grisegena*	Marsh bird	Coastal bays and estuaries during migration and winter	Fish, crustaceans, and aquatic insects	Diving and propelling through the water	No special status
Mute Swan	*Cygnus olor*	Marsh bird	Freshwater ponds, rivers, coastal lagoons, bays; in winter, common on	Aquatic vegetation, aquatic insects, fish, frogs	Plunge head below water surface	No special status

			marine waters			
American Coot	*Fulica americana*	Marsh bird	Open ponds and marshes; winters on coastal bays and inlets; feeds with ducks	Aquatic plants	Swims and dives for food	No special status
Pie-billed Grebe	*Podilymbus podiceps*	Marsh bird	Marshes, ponds; saltwater in winter if freshwater freezes	Fish, crustaceans, aquatic insects, crayfish	Dives for food	No special status
Eared Grebe	*Podiceps nigricollis*	Marsh bird	Prefers freshwater wetlands with large expanses of open water; open bays and ocean in winter	Aquatic insects, small crustaceans, and fish	Grazing, probing, dives for prey	No special status
American Bittern	*Botaurus lentiginosus*	Marsh bird	Saltwater marshes during migration and winter; does not nest in colonies	Insects, amphibians, crayfish, small fish and mammals	Forages; waits motionless for prey then catches and shakes or bites to kill	No special status

Appendix C

Copy of Correspondence

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

MassWildlife

Wayne F. MacCallum, *Director*

September 16, 2005

Department of the Army
New England District, Corps of Engineers
Attn: John Kennelly
Engineering/Planning Division, Evaluation Branch
696 Virginia Road
Concord, MA 01742-2751

Re: SEIS Boston Harbor Inner Harbor Maintenance Dredging Project
Main ship channel
Boston, MA
NHESP Tracking Number: 05-18181

Dear Mr. Kennelly,

Thank you for contacting the Natural Heritage and Endangered Species Program ("NHESP") of the MA Division of Fisheries & Wildlife for information regarding state-protected rare species in the vicinity of the site identified above.

In regard to the newly revised Massachusetts Endangered Species Act (MESA) regulations (321 CMR 10.00), the NHESP is currently in the process of evaluating whether or not your agency is subject to the fee normally associated with a rare species information request. In the interim we would like to offer the following comments regarding the above project:

At this time we are not aware of any state-listed rare plants or animals or exemplary natural communities in the immediate vicinity of this site and do not have any rare species concerns with the work as currently proposed.

This evaluation is based on the most recent information available in the NHESP database, which is constantly being expanded and updated through ongoing research and inventory. Should your site plans change, or new rare species information become available, this evaluation may be reconsidered.

Please note that this determination addresses only the matter of **rare** wildlife habitat and does not pertain to other wildlife habitat issues that may be pertinent to the proposed project.

We appreciate the Army Corps efforts to address rare species concerns during your project planning process. If you have any questions regarding this review please call Jenna Garvey, Environmental Review Assistant, at (508) 792-7270, ext. 303.

Sincerely,

Thomas W. French

Thomas W. French, Ph.D
Assistant Director

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO
ATTENTION OF

September 16, 2005

Engineering/Planning Division
Evaluation Branch

Ms. Cara Metz, Executive Director and SHPO
Massachusetts Historical Commission
The Massachusetts State Archives Building
220 Morrissey Boulevard
Boston, Massachusetts 02125

Dear Ms. Metz:

The U.S. Army Corps of Engineers, New England District, is preparing a Supplemental Environmental Impact Statement (SEIS) for the proposed Boston Harbor Inner Harbor Maintenance Project in Boston Harbor and vicinity (see project map). A copy of the Public Notice was provided to your office and the Massachusetts Board of Underwater Archaeological Resources (MA BUAR). Mr. Victor Mastone, director of the MA BUAR, responded to the Public Notice by letter dated June 21, 2005. A copy of his response letter is enclosed for your information. We would like your formal comments on the following undertaking.

The purpose of the Boston Harbor Inner Harbor maintenance dredging project is to increase the navigational efficiency and safety of Boston Harbor for present types of deep draft vessels. Maintenance dredging of the navigation channels landward of Spectacle Island is needed to remove shoals and restore the navigation channels to their authorized depths. Ships are currently experiencing tidal delays and potential damage from grounding.

The proposed Boston Harbor inner harbor maintenance project involves the dredging of the 35 and 40-foot Mean Lower Low Water (MLLW) Main Ship Channel from a point approximately halfway between Spectacle and Castle Islands inbound to the Inner Confluence. In addition, the upper (35 foot MLLW deep) portion of the Reserved Channel, the 40-foot MLLW deep approach channel to the Navy Dry Dock and the 35-foot MLLW deep Federal channel to the Charles River will also be dredged to their authorized depths. Recent surveys have identified some areas of ledge within the Federal project that will also be removed as part of the next maintenance dredging effort. A section of ledge, located in the Main Ship Channel between the 35 and 40-foot channels, as well as six separate ledge outcrops in the President Roads Anchorage will be also removed. In addition, the removal of a gas siphon in the Chelsea River near the Chelsea Street Bridge is being pursued which will allow additional dredging to be performed in the Chelsea River from immediately below, through and immediately upstream of the Chelsea Street Bridge which will restore the Chelsea River to its 38 foot MLLW authorized depth. The total quantity of material expected to be dredged is approximately 1.9 million cubic yards, of which 1.5 million cubic yards is unsuitable for ocean disposal.

Based on the alternative analysis conducted in the previous EIS, the likely plan for disposal of the unsuitable material will be the development and use of confined aquatic disposal (CAD) cells within the Federal channels of the project. Material determined to be suitable for ocean disposal will be disposed at the U.S. EPA designated Massachusetts Bay Disposal Site (MBDS).

Since the project consists solely of maintenance dredging of previously disturbed contexts, impacts to cultural resources are not expected. Additionally, the use of CAD cells for unsuitable material within the existing channel will also occur within previously disturbed areas. No impacts are expected. The MA BUAR has previously concurred with this determination as per the enclosed documentation. If project plans change and impacts are expected in previously undisturbed areas, we will notify the MA BUAR and your office to continue our coordination. If historic and/or archaeological resources are encountered during the maintenance dredging and disposal project, we will immediately notify all appropriate agencies consistent with the post-review guidance under the National Historic Preservation Act of 1966, as amended, and implementing regulations 36 CFR 800.

If you have any questions, please contact Mr. Marc Paiva of the Evaluation Branch at 978-318-8796.

CONCURRENCE: Brona Simon
9/22/05 BRONA SIMON
DEPUTY STATE HISTORIC
PRESERVATION OFFICER
MASSACHUSETTS
HISTORICAL COMMISSION

Sincerely,

H. Farrell McMillan

H. Farrell McMillan, P.E.
Chief, Engineering/Planning Division

Enclosures

Copy Furnished:
Mr. Victor Mastone, Director
Massachusetts Board of Underwater Archaeological Resources
241 Causeway Street, Suite 900
Boston, Massachusetts 02114-2136

Ms. Cheryl Andrews-Maltais, THPO
Wampanoag Tribe of Gay Head (Aquinnah)
20 Black Brook Road
Aquinnah, Massachusetts 02535

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

SEP - 6 2005

John R. Kennelly, Chief
Engineering/Planning Division, Evaluation Branch
Department of the Army
New England District, Corps of Engineers
696 Virginia Road
Concord, Massachusetts

Attn: Catherine Rogers

Dear Mr. Kennelly,

This is in response to your letter dated March 29, 2005 and phone conversations between Catherine Rogers of your staff and Julie Crocker of my staff on August 9, 2005 regarding section 7 consultation for two proposed dredging projects in Boston Harbor. The Army Corps of Engineers (ACOE) has made the preliminary determination that these dredging projects are not likely to adversely affect any threatened and/or endangered species listed under the jurisdiction of NOAA's National Marine Fisheries Service (NMFS).

Boston Harbor Deep Draft Navigation Improvement Project
As part of the Deep Draft Project, the ACOE proposes to make navigation improvements to portions of the Federal Navigation Project in the Port of Boston, which currently has a maximum authorized depth of -40 feet mean lower low water (MLLW). The port's entrance and main ship channels (up to the Ted Williams Tunnel), President Roads anchorage and lower Reserved Channel would be deepened to between 40 and 50 feet MLLW. Dredging would be conducted with a mechanical dredge. The project is expected to take approximately two to three years to complete and two to six million cubic yards (cy) of material will be removed. The majority of the dredged material would be suitable for ocean disposal at the Massachusetts Bay Disposal Site (MBDS). The material unsuitable for disposal at MBDS would be placed in the confined aquatic disposal (CAD) cells north of the Ted Williams Tunnel, most likely in the Mystic River, Chelsea River or Inner Confluence. Rock and/or cobble removed from the channels may be disposed for beneficial uses in one or more of the following nearshore areas: Nantasket Roads, Massachusetts Bay, Nahant Bay and an area off of the town of Magnolia.

Boston Harbor, Inner Harbor, Maintenance Dredging Project
The maintenance project involves the dredging of the -35 and -40 MLLW Main Ship Channel from a point approximately halfway between Spectacle and Castle Island inbound to the Inner Confluence. In addition, the upper portion of the Reserved Channel (-35 foot MLLW), the -40 foot MLLW deep approach channel to the Navy Dry Dock and the -35 foot MMLW deep Federal

channel to the Charles River will also be dredged to their authorized depths. Ledge within the Main Ship channel and ledge outcrops in the President Roads Anchorage will also be removed. In addition, the removal of a gas siphon in the Chelsea River near the Chelsea Street Bridge is being pursued which will allow additional dredging to be performed in the Chelsea River from immediately below, through and immediately upstream of the Chelsea Street Bridge which will restore the Chelsea River to its -38 foot MLLW authorized depth. Dredging would be conducted with a mechanical dredge. The total quantity of material expected to be dredged is approximately 1.9 million cy, of which 1.5 million cy is unsuitable for ocean disposal. Suitable material will be disposed of at the MBDS while the unsuitable material will be disposed of at CAD cells within the Federal channels of the project.

Three species of federally threatened or endangered sea turtles and three species of endangered whales may be found in Massachusetts waters. The sea turtles in Massachusetts nearshore waters are typically small juveniles with the most abundant being the federally threatened loggerhead (*Caretta caretta*) followed by the federally endangered Kemp's ridley (*Lepidochelys kempi*). Loggerheads and Kemp's ridleys have been documented in waters as cold as 11°C, but generally migrate northward when water temperatures exceed 16°C. These species are typically present in Massachusetts waters from June through November. Federally endangered leatherback sea turtles (*Dermochelys coriacea*) are located in New England waters during the warmer months as well. While leatherbacks are predominantly pelagic, they may occur close to shore, especially when pursuing their preferred jellyfish prey. Green sea turtles *(Chelonia mydas)* may also occur sporadically in New England waters, and any occurrence in Massachusetts waters is likely to be rare. Sea turtles are known to occur on Stellwagen Bank and in Massachusetts Bay. While no surveys for sea turtles have been conducted in Boston Harbor, suitable forage and habitat exists in this area and it is likely that sea turtles occasionally are present in Boston Harbor.

Federally endangered North Atlantic right whales (*Eubalaena glacialis*) and humpback whales (*Megaptera novaeangliae*) are also found seasonally in Massachusetts waters. North Atlantic right whales have been documented in the nearshore waters of Massachusetts from December through June. Humpback whales feed during the spring, summer, and fall over a range that encompasses the eastern coast of the United States, including Massachusetts Bay. While these whale species are not considered residents of the Boston Harbor area, transients occasionally enter the area as they complete seasonal migrations in nearby Massachusetts Bay. For example, in April 1996 a right whale was documented in Boston Harbor and in the fall of 2000, a humpback whale was documented in Boston Harbor. Fin (*Balaenoptera physalus*), Sei (*Balaenoptera borealis*) and Sperm (*Physter macrocephalus*) whales are also seasonally present in New England waters but are typically found in deeper offshore waters and are not likely to occur in Boston Harbor.

Dredge operations have been documented to injure and kill sea turtles. However, all of these instances have occurred with hydraulic hopper dredge operations. If sea turtles were present during dredging operations, it is expected that they will be able to avoid the mechanical dredge to be used. As such, no direct effects to sea turtles are likely to occur during dredging operations. Dredge operations will destroy the existing benthic community in dredged areas and most sedentary organisms associated with the bottom sediments would be killed. Most motile organisms, such as crabs and finfish, are expected to avoid the dredge. As sea turtles are highly mobile and suitable foraging areas occur elsewhere in the vicinity of the proposed project, the loss of potential sea turtle forage items will not affect sea turtles. Recolonization of the dredged area is expected to be rapid; studies have indicated that pre-dredging conditions in a channel can be reestablished in as little as one month after dredging ceases. In addition, Boston Harbor is not known to be a high use area for sea turtles and any effects on the forage base for sea turtles will be insignificant. As listed whales are not likely to occur in Boston Harbor, they are not likely to be affected by the proposed dredging activities.

Dredging projects in industrial ports have the potential to affect water quality in the surrounding waters. However, no water quality violations have been recorded during monitoring of previous navigation improvement projects in Boston Harbor and the ACOE has indicated that no water quality impacts are expected from these projects. As such, no impacts to listed species from alterations in water quality in Boston Harbor are likely as a result of dredging and disposal operations.

Sea turtles and/or whales may be encountered at the MBDS and/or on the way to/from the disposal area. Separate Section 7 consultation between the ACOE and NMFS was concluded on the use of the MBDS in a letter dated August 29, 1997. It is the understanding of NMFS that all restrictions outlined in that letter will be adhered to during disposal operations for these projects.

Based on the analysis above, NMFS concurs with the ACOE's determination that this project is not likely to adversely affect any listed species under the jurisdiction of NMFS. Therefore, no further consultation pursuant to Section 7 of the ESA is required. Should project plans change or new information become available that changes the basis for this determination, consultation should be reinitiated. Should you have any questions about these comments, please contact Julie Crocker at (978) 281-9300 ext. 6530.

Sincerely,

Patricia A. Kurkul
Regional Administrator

Cc: Collins, GCNE
Williams, GCNE
Boelke, F/NER4

File Code: Sec 7 ACOE Mass. Boston Harbor Deep Draft and Maintenance Dredging
PCTS I/NER/2005/04609

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

OFFICE OF THE
REGIONAL ADMINISTRATOR

August 31, 2005

John Kennelly
Chief of Planning
United States Army Corps of Engineers
696 Virginia Road
Concord, Massachusetts 01742-2751

RE: Supplemental Environmental Impact Statement (SEIS) for the Boston Harbor Inner Harbor Maintenance Dredging Project

Dear Mr. Kennelly:

This letter responds to your request for the Environmental Protection Agency (EPA) to participate as a cooperating agency during the preparation of the Supplemental Environmental Impact Statement (SEIS) for the Boston Harbor Inner Harbor Maintenance Dredging Project. EPA New England agrees to participate as a cooperating agency during the preparation of a SEIS for the project.

EPA intends to work as a cooperating agency within the limit of our resources to help define the scope of analysis, identify sources of information and to offer input on how specific issues should be addressed in the SEIS. We encourage the Corps to continue to coordinate closely with local, state and federal agency representatives throughout the NEPA process.

Phil Colarusso of EPA's Office of Ecosystem Protection (617/918-1506) will serve as EPA's primary point of contact for the project.

Sincerely,

Robert W. Varney
Regional Administrator

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
OFFICE OF COASTAL ZONE MANAGEMENT
251 Causeway Street, Suite 800, Boston, MA 02114-2136
(617) 626-1200 FAX: (617) 626-1240

August 8, 2005

John R. Kennelly
US Army Corps of Engineers
New England District
Engineering/Planning Division
696 Virginia Road
Concord, MA 01742-2751

Dear Mr. Kennelly:

This letter is in response to your letter dated July 6, 2005, requesting comment on the preparation of a Supplemental Environmental Impact Statement (SEIS) for the Boston Harbor Inner Harbor Maintenance Dredging Project. The Massachusetts Office of Coastal Zone Management (CZM) has reviewed the information provided in your letter, and the Public Notice issued by the US Army Corps of Engineers' (Corps) for the project dated June 17, 2005 and offers the following comments

Project Description

Based on the information provided in the Public Notice, CZM understands that the proposed project would dredge approximately 1.9 million cubic yards (cy) of material from the Main Ship Channel, the upper portion of the Reserved Channel, the approach to the Navy Dry Dock, the Federal channel to the Charles River, and possibly the Chelsea Creek. Areas of ledge in the Main Ship Channel and the President Roads Anchorage are also proposed for removal. Approximately 1.5 million cy of material is unsuitable for ocean disposal at the Massachusetts Bay Disposal Site, and this material is likely to be disposed in confined aquatic disposal (CAD) cells within the Federal channels.

Technical Working Group

CZM participated in the Technical Working Group for the recently completed Boston Harbor Navigation Improvement Project, and looks forward to participating in a similar process as the planning for this project continues.

Potential Disposal Impacts

As part of the recently completed Boston Harbor Navigation Improvement Project (BHNIP), the Corps used in-channel CAD cells for disposal of dredged sediment unsuitable for disposal at the state approved ocean disposal site. Certain of these CAD cells, though approved through the BHNIP, were not used during the BHNIP, and are proposed for use with this project. CZM supports the assessment of such cells for unsuitable material in this project, since the environmental documentation and regulatory process associated with the BHNIP was focused on the environmental issues associated with this disposal method. CZM looks forward to reviewing information in the SEIR for this project that builds upon the previous evaluations as necessary.

In this context, CZM requests that the Corps summarize the "lessons learned" from the BHNIP project, drawing upon sources such as the 2002 BHNIP summary report. In particular, an evaluation of the water quality monitoring methodology, geographical behavior of the CAD cells, and other available information related to marine habitat impacts, as well as efforts to provide communication and outreach to affected stakeholders, will be useful in the evaluation of the proposed project.

Additional Review

The proposed project will be subject to CZM federal consistency review, in which case the project must be found to be consistent with CZM's enforceable program policies. For further information on this process, please contact Alex Strysky, Project Review Coordinator, at 617-626-1219 or visit the CZM web site at www.state.ma.us/czm/fcr.htm.

CZM appreciates the opportunity to comment on this project, and looks forward to working with the Corps, Massport, and other parties as the project moves ahead. CZM also looks forward to reviewing the SEIR and will provide detailed comments at that time. John Weber of our office has been involved in the recent Technical Work Group activities and will continue to serve as the main point of contact for the project. He can be reached at 617-626-1064 or by e-mail at john.weber@state.ma.us

Sincerely,

Susan Snow-Cotter
Director

SSC/jw

cc: Catherine Rogers, USACE
Michael Keegan, USACE
Deb Hadden, Massport
Robert Varney, USEPA
Michael Bartlett, USFWS
Paul Diodati, MA DMF
Lealdon Langley, MA DEP

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

August 5, 2005

Reference:	Project	Location
	SEIS, maintenance dredging	Boston Harbor Inner Harbor, MA

John R. Kennelly, Chief of Planning
U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Dear Mr. Kennelly:

This responds to your recent correspondence requesting information on the presence of federally-listed and/or proposed endangered or threatened species in relation to the proposed activity(ies) referenced above.

Based on information currently available to us, no federally-listed or proposed, threatened or endangered species or critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area(s). Preparation of a Biological Assessment or further consultation with us under Section 7 of the Endangered Species Act is not required.

This concludes our review of listed species and critical habitat in the project location(s) and environs referenced above. No further Endangered Species Act coordination of this type is necessary for a period of one year from the date of this letter, unless additional information on listed or proposed species becomes available.

Furthermore, we have no comments on the project with regard to the Fish and Wildlife Coordination Act.

Thank you for your coordination. Please contact us at 603-223-2541 if we can be of further assistance.

Sincerely yours,

Michael J. Amaral

Michael J. Amaral
Endangered Species Specialist
New England Field Office

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD. MASSACHUSETTS 01742-2751

REPLY TO:
ATTENTION OF:

August 1, 2005

Programs/Project Management Division
Programs & Civil Project Management Branch

Mr. Peter Davidoff
Bosport Docking, LLC
D/b/a Constitution Marina
28 Constitution Road
Boston, MA 02129

Dear Ms. Davidoff:

This is to confirm our meeting on Thursday, August 4, 2005 at 10:00 a.m. in your Boston office to discuss the Boston Harbor Inner Harbor Federal Channel Maintenance Dredging Project. In your letter of July 8, 2005, in response to a recent public notice outlining the proposed project, you requested that we conduct a public hearing on the project so that you could provide comments and your concerns regarding the project. It is my understanding that the August 4, 2005 meeting to discuss the proposed project will meet your needs and that you no longer are requesting a public hearing be held. I look forward to meeting with you and discussing the proposed maintenance project.

If you have any questions or require additional information, please contact me at 978-318-8087. I may also be contacted by email at michael.f.keegan@usace.army.mil

Sincerely,

Michael F. Keegan

Michael F. Keegan, P.E., L.C.S
Project Manager

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

JUL 21 2005

Mr. Michael Keegan
US Army Corps of Engineers
New England District
Programs and Project Management Division
696 Virginia Road
Concord, MA 01742-2751

Re: Boston Harbor Inner Harbor Maintenance Dredging Project

Dear Mr. Keegan:

The National Marine Fisheries Service (NMFS) has reviewed the Army Corps of Engineers' (ACOE) Public Notice for the Maintenance Dredging of Boston Inner Harbor, in Boston, Massachusetts. The proposed project would remove approximately 1.9 million cubic yards of material from the Main Ship Channel, the upper portion of the Reserved Channel, the approach channel to the Navy Dry dock, the federal channel to the Charles River and the Chelsea River, to restore authorized depths. In addition, areas of ledge found within the Main Ship Channel and the President Roads anchorage area will be removed. As stated within the public notice, approximately 1.5 million cubic yards of material is unsuitable for disposal at the Massachusetts Bay Disposal Site (MBDS), and will likely be disposed in confined aquatic disposal (CAD) cells to be located within the federal channels of the project.

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires federal agencies such as the ACOE to consult with the Secretary of Commerce regarding any action or proposed action authorized, funded, or undertaken by the agency that may adversely affect EFH identified under the MSA. The EFH regulations, 50 CFR Section 600.920, outline that consultation procedure and, further, enables federal agencies to use existing consultation/environmental review procedures to satisfy the MSA consultation requirements in certain circumstances. Also, NMFS previously reported to your agency in a letter dated January 18, 2000 that the National Environmental Policy Act (NEPA) process may be used to satisfy the consultation requirements of the MSA. It is our understanding that an EFH assessment and Supplemental Environmental Impact Statement (SEIS), as required under MSA and NEPA, respectively, are in the process of being developed. At this time, we have not received either of these documents and, therefore, an EFH consultation between our agencies has not been initiated by the ACOE.

EFH Assessment

Insofar as this project involves essential fish habitat (EFH), this process is guided by the requirements of our EFH regulation at 50 CFR 600.905, which mandates the preparation of EFH assessments and generally outlines each agency's obligations in this consultation procedure.

In order to satisfy consultation requirements of the EFH regulations [50 CFR 600.920(e)], an EFH assessment must be prepared to analyze the effects of the proposed action on EFH. The required contents of an EFH assessment include: 1) a description of the action; 2) an analysis of the potential adverse effects of the action on EFH and the managed species; 3) the ACOE's conclusions regarding the effects of the action on EFH; and 4) proposed mitigation, if applicable. Other information that should be contained in the EFH assessment, if appropriate, includes: 1) the results of on-site inspections to evaluate the habitat and site-specific effects; 2) the views of recognized experts on the habitat or the species that may be affected; 3) a review of pertinent literature and related information; and 4) an analysis of alternatives to the action that could avoid or minimize the adverse effects on EFH. Upon submittal of an EFH assessment, NMFS will provide official conservation recommendations for the proposed project.

Essential Fish Habitat

EFH has been designated for a number of federally managed species within the proposed work area. A complete list of species and life stages that have been designated for the proposed project location can be found on the NMFS Habitat Conservation Division website at http://www.nero.noaa.gov/ro/doc/webintro.html

Among those species listed, particular attention should be focused on winter flounder (*Pseudopleuronectes americanus*) habitat that may be adversely affected by this project. Adult winter flounder use this area for spawning and feeding, while eggs, larvae, and juveniles use the area for early life stage development. Suspended sediment deposition resulting from the proposed project can adversely affect winter flounder eggs and juvenile development. Winter flounder have been identified throughout the harbor as well as within the Mystic and Chelsea Rivers. Other EFH species that have been identified within the project footprint should be evaluated for adverse effects resulting from the proposed project.

Finfish and shellfish resources under the Fish and Wildlife Coordination Act

The substrate found within the project area also serves as habitat for benthic organisms, such as shellfish and other invertebrates living within and on the surface of the sediment. These organisms contribute to the productivity of the federally managed species by acting as a food source for both juvenile and adult life stages of finfish. Shellfish resources of concern within the project area include lobster, soft-shelled clams, blue mussels, and surf clams. Surf clams are present within the vicinity of Broad Sound. Shellfish resources may be adversely affected by the proposed project through direct impact (i.e., dredge) or by elevated levels of suspended sediment that can interfere with spawning success, juvenile development, and feeding.

In addition, the anadromous rainbow smelt, alewife, and blueback herring use Boston Harbor, the Mystic River, and the Chelsea River for passage to upstream spawning locations. Elevated levels of suspended sediment can serve as an impediment to passage if work is performed during upstream and downstream migrations. In order to avoid adverse impacts on the resource, dredge work should be timed accordingly. Upon review of the SEIS, conservation recommendations will be provided in order to avoid and minimize adverse effects to the above referenced NMFS trust resources.

Protected Resources

Three species of federally threatened or endangered sea turtles and three species of endangered whales may be found in Massachusetts waters. The sea turtles in northeastern nearshore waters are typically small juveniles with the most abundant being the federally threatened loggerhead (*Caretta caretta*) followed by the federally endangered Kemp's ridley (*Lepidochelys kempi*). Loggerhead turtles have been found to be relatively abundant off the Northeast coast (from near Nova Scotia, Canada to Cape Hatteras, North Carolina). Loggerheads and Kemp's ridleys have been documented in waters as cold as 11°C, but generally migrate northward when water temperatures exceed 16°C. These species are typically present in Massachusetts waters from June through October. Federally endangered leatherback sea turtles (*Dermochelys coriacea*) are located in New England waters during the warmer months as well. While leatherbacks are predominantly pelagic, they may occur close to shore, especially when pursuing their preferred jellyfish prey. Green sea turtles *(Chelonia mydas)* may also occur sporadically in Massachusetts waters, but those instances would be rare. Sea turtles are not likely to occur in the area to be dredged and any occurrence in the Boston Harbor area would be an unlikely event.

Federally endangered North Atlantic right whales (*Eubalaena glacialis*), humpback whales (*Megaptera novaeangliae*), and fin whales (*Balaenoptera physalus*) may also be found seasonally in Massachusetts waters. North Atlantic right whales have been documented in the nearshore waters of Massachusetts from December through June. Humpback whales feed during the spring, summer, and fall over a range that encompasses the eastern coast of the United States. Fin whales are common in waters of the United States Exclusive Economic Zone, principally offshore from Cape Hatteras northward. While these whale species are not considered residents of the Boston Harbor area, it is possible that transients may enter the area during seasonal migrations. While possible, it is unlikely that any of these whale species would be present in the area to be dredged.

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended, states that each federal agency shall, in consultation with the Secretary, insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Because federally listed species may be present in the vicinity of the project area, any discretionary federal action that may affect these species must undergo Section 7 consultation. The federal action agency, in this case the ACOE, would be responsible for initiating Section 7 consultation, at which time the project details would be submitted to the National Marine Fisheries Service, Northeast Regional Office, One Blackburn Drive, Gloucester, MA 01930. An assessment of the project's impacts on federally endangered species should be included with the project details. After reviewing this information, NMFS would then be able to conduct a consultation under section 7 of the ESA.

Thank you for your coordination with NMFS regarding this project. If you have specific questions regarding these comments, please contact Christopher Boelke at 978-281-9131 for EFH issues, or Julie Crocker at 978-281-9328, ext. 6530, for protected resources issues or the section 7 consultation process in general.

Sincerely,

Stanley Gorski

for Peter D. Colosi
Assistant Regional Administrator
for Habitat Conservation

cc: Mary Colligan, NOAA/NMFS/PRD
Robert Varney, US EPA
Michael Bartlett, US FWS
Paul Diodati, MA DMF
Susan Snow-Cotter, MA CZM
Lealdon Langley, MA DEP

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

JUL 19 2005

Mr. John Kennelly
Chief of Planning
Engineering/Planning Division
Evaluation Branch
US Army Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742

Re: Boston Harbor Inner Harbor Maintenance Dredging Project

Dear Mr. Kennelly:

This responds to your letter requesting the National Marine Fisheries Service (NMFS) to participate as a cooperating agency in the preparation of a Supplemental Environmental Impact Statement (SEIS) for the Boston Harbor Inner Harbor Maintenance Dredging Project. NMFS agrees to participate as a cooperating agency to help advance effective interagency coordination on the SEIS for this project, in accordance with the Council of Environmental Quality (CEQ) regulations (40 CFR 1501.6).

Our role and degree of involvement as a cooperator is dependent on existing staff and fiscal resources capabilities. Our contributions generally will be limited to scoping, identification of issues and topics that need consideration and evaluation in the SEIS, review of documents, and routine attendance at meetings. We are not in a position to undertake data collection, conduct analyses, or prepare sections of the draft or final SEIS, as staff and resources are fully tasked in other obligatory NMFS programs.

We have been involved with the Boston Harbor Inner Harbor Maintenance Dredging Project as well as the Boston Harbor Deep Draft Navigation Improvement Project through participation on the Technical Working Group (TWG). To date, we have provided comments on site selection criteria for the beneficial use of material from the channel within Boston Harbor, and have offered site-specific information regarding NMFS trust resources expected to be within the project area. As we continue to move through the project review process, NMFS will be in a position to provide an exposition of issues from the standpoint of our federal mandates and will work collegially with the federal partners.

I understand that the next steps will be the review of the Draft Supplemental Environmental Impact Statement to evaluate the potential impacts of the proposed project. We expect there to be increasing public attention directed to this project and we will make every reasonable effort to work with your staff to review and provide comments on this project. If you have any questions pertaining to this letter, please contact Christopher Boelke of my staff at (978) 281-9131. We look forward to exploring the issues associated with the Boston Harbor Inner Harbor Maintenance Dredging Project as it moves through the public review process.

Sincerely,

Patricia A. Kurkul
Regional Administrator

cc: Mike Bartlett, US FWS
Robert Varney, US EPA
Christine Godfrey, US ACOE
Peter Colosi, NMFS
Paul Diodati, MA DMF

Bosport Docking, LLC
d/b/a/ Constitution Marina
28 Constitution Road
Boston, MA 02129
davidoff@bosport.com

Phone: (617) 241-9640 Fax: (617) 242-3013 Monitoring: VHF 69

July 8, 2005

Mr. Michael Keegan - District Engineer
Attn: Programs and Project management Division
Army Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751

Dear Mr. Keegan,

I am requesting a hearing on the "Boston Harbor, Inner Harbor, Maintenance Dredging Project. I own Constitution Marina located adjacent to the dredging of the basin leading to the Charles River locks.

My concerns are for the safety of my boaters and my facility during the dredging project. Wave action caused by the dredging may endanger customers on the docks as well as damage boats. My marina is a bottom anchored system and may be affected by this dredging project. It appears that the dredging will continue from the main shipping channel up toward the Charles River Locks.

I would like to know the reasoning for dredging the Charles River section; it is only used for light barge, tour boat and recreational boating. I believe the existing working depths are in are excess of the needs for all of the uses. Due to development of the area and the immovable bridge and limited size of the Charles River Locks, the likelihood of large vessels using this area is unlikely. The lower Charles River Basin near Pier One docking the USS Constitution and visiting vessels would be the only areas that may need dredging.

Please let me know when the hearing is scheduled and how we can help with this project.

Sincerely,

Peter Davidoff

Peter Davidoff

Clean Water Act

Section 404(b)(1) Evaluation

NEW ENGLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS

CLEAN WATER ACT SECTION 404(b)(1) GUIDELINES

PROJECT: Boston Harbor Inner Harbor Maintenance Dredging Project, Boston, Massachusetts

PROJECT DESCRIPTION:

The currently proposed Inner Harbor Maintenance Dredging Project (IHMDP) involves dredging approximately 1.7 million cubic yards (cy) of silty maintenance material from the Main Ship Channel located approximately half-way between Spectacle Island and Castle Island upstream to the Inner Confluence, the upper Reserved Channel, and the approach to the Navy Dry Dock to their authorized depths. Approximately 1.3 million cy of the maintenance material is unsuitable for unconfined open water disposal and will be disposed into confined aquatic disposal (CAD) cells located in or near the sites identified in the BHNIP EIR/S.

Recent geotechnical investigations in the Mystic River and the Inner Confluence revealed the presence of ledge near the surface in many locations. This constrains the construction of new CAD cells and limits the available area for CAD cell construction. Therefore a new location for a CAD cell has been identified within the limits of the existing navigation channel. The CAD cells will be located in the Mystic River navigation channel and the Main Ship navigation channel.

The silty maintenance material suitable for ocean disposal and the approximate 1.5 million cy of parent material removed to construct the CAD cells will be disposed at the Massachusetts Bay Disposal Site (MBDS). The total amount of material to be dredged from the project and disposed into CAD cells or the MBDS is approximately 3.2 million cy. In addition to the dredged material, about 12,000 cy of rock will be removed. Recent surveys have identified some areas of ledge within the Federal navigation project that will also be removed as part of this maintenance dredging effort: a section of ledge, located in the Main Ship Channel between the 35 and 40-foot channels; as well as six separate ledge outcrops in the west end of the President Roads Anchorage. Dredging and disposal activities are expected to take about two years to complete.

The U.S. Army Corps of Engineers (Corps), Massachusetts Port Authority (Massport) and the Commonwealth of Massachusetts are working together to compel Keyspan Gas remove its gas siphon in the Chelsea River located south of the Chelsea Street Bridge. The continued presence of this pipeline prevented completion of BHNIP dredging in this area. If the line is relocated prior to completion of the Inner Harbor Maintenance Dredging Project, the BHNIP maintenance and improvement dredging will be performed in this area to deepen the Chelsea River to its –38 foot MLLW authorized depth. If the line is not removed ny Keyspan, then the Chelsea River area will be maintenance dredged to –35 feet MLLW. The material will be disposed into CAD cell C12, located north of the Chelsea Street Bridge, which was permitted and constructed for the BHNIP.

PROJECT: Inner Harbor Maintenance Dredging, Boston, Massachusetts

1. Review of Compliance (Section 230.10(a)-(d)).

Draft

a. The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose;

X **YES** ___ **NO**

b. The activity does not appear to:
1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of the CWA; 2) jeopardize the existence of Federally listed threatened and endangered species or their critical habitat; and 3) violate requirements of any Federally designated marine sanctuary;

X **YES** ___ **NO**

c. The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values;

X **YES** ___ **NO**

d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem.

X **YES** ___ **NO**

2. Technical Evaluation Factors (Subparts C-F).

	N/A	Not Significant	Significant
a. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C).			
1) Substrate;		X	
2) Suspended particulates/turbidity;		X	
3) Water;		X	
4) Current patterns and water circulation;	X		
5) Normal water fluctuations;	X		
6) Salinity gradients.	X		
b. Potential Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D).			
1) Threatened and endangered species;		X	
2) Fish, crustaceans, mollusks and other aquatic organisms in the food web;		X	
3) Other wildlife.	X		
c. Potential Impacts on Special Aquatic Sites (Subpart E).			
1) Sanctuaries and refuges;	X		
2) Wetlands;	X		
3) Mud flats;	X		
4) Vegetated shallows;	X		
5) Coral reefs;	X		
6) Riffle and pool complexes.	X		
d. Potential Effects on Human Use Characteristics (Subpart F).			
1) Municipal and private water supplies;	X		
2) Recreational and commercial fisheries;		X	
3) Water related recreation;		X	
4) Aesthetics;		X	
5) Parks, national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves.	X		

3. **Evaluation and Testing (Subpart G).**

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)

1) Physical characteristics; .... _X
2) Hydrography in relation to known or anticipated sources of contaminants;.. _X
3) Results from previous testing of the material or similar material in the vicinity of the project;……………….x
4) Known, significant sources of persistent pesticides from land runoff or percolation;
5) Spill records for petroleum products or designated hazardous substances (Section 311 of CWA);
6) Public records of significant introduction of contaminants from industries, municipalities, or other sources;
7) Known existence of substantial material deposits of substances that could be released in harmful quantities to the aquatic environment by man-induced discharge activities;
8) Other sources (specify).

List appropriate references.

Boston Harbor Inner Harbor Maintenance Dredging SEIS

b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredge or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and disposal sites and not likely to require constraints in handling the material. The material meets the testing exclusion criteria.

_X_ ___
YES **NO**

4. <u>Disposal Site Delineation (Section 230.11(f)).</u>

a. The following factors, as appropriate, have been considered in evaluating the disposal sites.

1) Depth of water at disposal site	_X_
2) Current velocity, direction, and variability at disposal site	_X_
3) Degree of turbulence	_X_
4) Water column stratification.	_X_
5) Discharge vessel speed and direction.	___
6) Rate of discharge	_X_
7) Dredged material characteristics (constituents, amount, and type of material, settling velocities)	_X_
8) Number of discharges per unit of time	___
9) Other factors affecting rates and patterns of mixing (specify: disposal at low and high tide)	_X_

<u>List appropriate references</u>.

<u>Boston Harbor Inner Harbor Maintenance Dredging</u>

b. An evaluation of the appropriate factors in 4a above indicates that the disposal site and/or size of mixing zone are acceptable

YES	**NO**
X	

5. <u>Actions To Minimize Adverse Effects (Subpart H).</u>

All appropriate and practicable steps have been taken through application of recommendation of Section 230.70 - 230.77 to ensure minimal adverse effects of the proposed discharge

YES	**NO**
X	

<u>List actions taken.</u>

1). An enclosed "environmental" bucket will be used for silt dredging. No overflow from the scows will be allowed to reduce the effects of turbidity on water quality.
2). Disposal into the CAD cells will occur only around periods of slack tide: three hours at low tide and high tide (one hour before and two hours after slack tide).
3). A three-foot sand cap will be placed in the CAD cells when the silt has consolidated enough to support a cap. The cap material will be released from a moving, not stationary platform. No spudding will be allowed over the cap or mechanical disturbance of the cap.
4). To reduce the impact to biological resources from blasting, all blasting will be conducted using inserted delays of a fraction of a second per hole. Stemming will use rock or similar

material placed into the top of the borehole to deaden the shock wave reaching the water column. A fisheries and mammal observer, and fish detecting sonar system, will be used to avoid blasting when mammals are present in the area or when significant schools of fish are observed.
5). A fisheries observer, sonar detection, and a startle system from February 15 to June 15 will be required for the Mystic River and Main Ship Channel CAD disposal activities to avoid disposal during the presence of anadromous fish migration.
6). reduce potential impacts to ovigerous lobsters that are less mobile in the colder months, no dredging or blasting will occur seaward of the Third Harbor Tunnel between December 1 and March 31.

6. <u>Factual Determination (Section 230.11).</u>

A review of appropriate information as identified in items 2 - 5 above indicates that there is minimal potential for short or long term environmental effects of the proposed discharge as related to:

a. Physical substrate (review sections 2a, 3, 4, and 5 above).	YES <u>X</u>	NO___
b. Water circulation, fluctuation and salinity (review sections 2a, 3, 4, and 5).	YES <u>X</u>	NO___
c. Suspended particulates/turbidity (review sections 2a, 3, 4, and 5).	YES <u>X</u>	NO___
d. Contaminant availability (review sections 2a, 3, and 4).	YES <u>X</u>	NO___
e. Aquatic ecosystem structure, function and organisms(review sections 2b and c, 3, and 5)	YES <u>X</u>	NO___
f. Proposed disposal site (review sections 2, 4, and 5).	YES <u>X</u>	NO___
g. Cumulative effects on the aquatic ecosystem.	YES <u>X</u>	NO___
h. Secondary effects on the aquatic ecosystem.	YES <u>X</u>	NO___

7. <u>Findings of Compliance or Noncompliance.</u>

a. The proposed disposal site for discharges of dredged or fill material complies with the Section 404(b)(1) guidelines.. **<u>X</u>**
YES

____
DATE

____
CURTIS L. THALKEN
Colonel, Corps of Engineers
District Engineer